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The Naiadaceæ of North America.

By Thomas Morong.

(Plates XX.—LXXIV.)

The first botanist to reduce the North American species of *Potamogeton* to anything like a complete and intelligible systematic shape was Dr. J. W. Robbins, of Uxbridge, Mass. To his pen is due the description in Gray's Manual, edition 5, of the species within the range of that work. To this he added in the Botany of King's Expedition an account of the species found in Nevada, Utah and the adjoining regions, completing his work in the Botany of California by Brewer and Watson by a determination of the species on the Pacific coast which were then known. At his death, in 1875, Dr. Robbins bequeathed to me his collections, containing not only the gatherings of many years by his own hand, but also specimens from the Herbarium of Tuckerman, one of the earliest students of this genus, and from Oakes, his close friend and collaborator, in whose lamented early death our country lost one of its most promising naturalists. Dr. Robbins left with his Herbarium an injunction that his plants should be distributed as widely as possible. I feel, therefore, that I am executing a sacred trust in issuing a monograph upon the Order that includes as its principal part the family upon which my friend expended so much thought. Besides this, the paper here presented includes not only the embodiment of my friend's most cherished convictions, but the results of my own studies in a personal exploration of nearly all the waters from Quebec to Virginia, and from the Atlantic to the Mississippi. This monograph, however,

would have been impossible, at least in its present form, except for the assistance of friendly European botanists to whom I am indebted for large suites of specimens and invaluable counsel. With Mr. Arthur Bennett, of Croydon, England, distinguished for his extensive acquaintance with *Potamogeton* forms in all parts of the world, and for his contributions to the literature of the subject, I have enjoyed a correspondence covering the last twelve years, and during the course of that time have received from him specimens of *Naias*, *Zanichellia*, *Ruppia*, *Zostera* and *Potamogeton*, which represent nearly all the species of these families known to European Herbaria. His generous assistance has not ended here, but he has examined for me the materials at Kew, the London Museum of Natural History, Berlin and the Herbarium of Linnæus, so that I feel as well acquainted with these great collections as if I had visited them in person. I am also much beholden to that acute botanist of Cambridgeshire, England, Mr. Alfred Fryer, for beautiful specimens of the various interesting forms of Potamogeton which occur in the fens about Chatteris, and for many original and discriminating analyses. Elegant specimens of the Northern Scandinavian forms have been contributed by Dr. Gustaf Tiselius, of Stockholm, than whom no one is a better judge of the Continental species of Potamogeton. The late Prof. Caspary, of Königsburg, Prussia, was another of my European correspondents, from whom was received many valuable specimens. The collections of the Harvard Herbarium, of Columbia College, the Academy of Sciences at Philadelphia, and at the National Herbarium at Washington have been freely submitted for examination, as well as the large private collections of Mr. Canby, of Wilmington, Delaware, I. C. Martindale, of Camden, New Jersey, and others. Indeed, I may say that there is scarcely a collector of pond weeds in the country with whom I have not at one time or other held correspondence, and from whom I have not received specimens. And yet, notwithstanding these advantages for a wide comparison and a close study of this group of plants, so protean are their forms, so eccentric their action, constantly changing under changed conditions of season and water, that I put forth this treatise with great diffidence, and feel that the subject is very far from being exhausted

The Naiadaceæ are for the most part strictly aquatic plants, arising from long, sometimes nodose, rhizomes. Two of the genera now included in the order, *Triglochin* and *Scheuchzeria*, are inhabitants of bogs and marshes; while another, *Lilæa*, usually begins its life under water, but continues to grow in the mud after its native water has subsided. *Triglochin* and *Lilæa* bear their inflorescence on scapes, the remainder on branching and leafy stems. The aquatics are normally submerged plants, but some of the *Potamogeton* family bear two kinds of leaves, floating and submerged. The leaves are properly sheathing at the base, and this appears in all the genera, except in some species of *Potamogeton*. Even these, however, as in the group of which *P. pectinatus* may be considered as the type, the so-called stipule is adnate to the base of the leaf and forms with it a sheath, produced at its extremity into a sort of ligule. In the other species this organ, though, for want of a better name, it is termed a stipule, is much more in the nature of a spathe that at first encloses the young buds, remaining afterwards at the base of the elongated nodes, petioles and peduncles as an appendage which soon decays. In *Zostera* and *Phyllospadix* the spathaceous character is still more developed as the flowers are borne on true spadices contained in a foliaceous sheath or spathe. Flowers perfect, monœcious or dicœcious, either naked, tubular, or with a perianth of 4 to 6 distinct herbaceous segments. Stamens 1 to 6, occasionally more, distinct and hypogynous in the perfect flowers, solitary or connate in the unisexual, with extrorse 1–2-celled anthers. Ovaries 1 to 6, distinct or rarely connate, 1-celled; containing in our North American species, with few exceptions, a single ovule. Fruit, various; capsular, follicular or drupaceous. The fruit in the *Zostereæ* is usually termed an utricle, but, while having a membranaceous pericarp, it is frequently, at least, if not always, dehiscent. Seed straight or curved; the embryo corresponding, orthotropous, anatropous or campylotropous, without albumen.

From this brief characterization it will be seen that the order is composed of several heterogeneous groups. With the exception of the Juncagineæ and Lilaeæ the order is a natural one. These two groups have long hovered between Alismaceæ, Aroideæ and Naiadaceæ, with all of which they are more or less closely allied,

and yet they are really distinct from either, and a rigid classification would certainly follow the arrangement of Micheli in D. C. Mon. Phan., and constitute each of them a separate order. *Lilæa* is anomalous, and quite as distinct from the Juncagineæ as the latter are from Naiadaceæ. There is an advantage, however, in placing closely allied groups under one order, if possible, and I therefore follow essentially the arrangement of Bentham and Hooker.

Sub-order I. JUNCAGINEÆ.

Marsh plants with rush-like leaves. Flowers spicate or racemose, perfect. Perianth 4-6-parted; segments in two series. Stamens 3-6. Carpels 3 or 6, 1-2-ovuled, more or less united while immature, dehiscent or indehiscent. Seeds anatropous, embryo straight.

1. TRIGLOCHIN.

Flowers ebracteate, racemose. Perianth segments 3 or 6. Carpels 3 or 6, united until maturity. Leaves all radical.

2. SCHEUCHZERIA.

Flowers bracteate, racemose. Perianth segments 6. Stamens 6. Carpels 3, distinct, stem leafy, rush-like; fruit a follicle.

Sub-order II. LILAEÆ.

Marsh plants with cylindrical leaves. Flowers dimorphous, solitary and in spikes, monœcious. Perianth none or a single bract. Stamen 1, ovary 1, ovule 1, anatropous. Carpels indehiscent.

3. LILAEA. Flowers monœcious, the pistillate naked at the base of the leaves, with very long styles, or in close spikes on scapes; the staminate in close spikes, on scapes, under a single bract. Carpel 1, 1-seeded.

Sub-order III. NAIADEÆ.

Immersed aquatics with flat leaves. Flowers variously arranged, perfect, monœcious or diœcious. Perianth of 4 segments, or a mere hyaline envelope. Ovaries solitary or distinct, 1-ovuled. Carpels rarely dehiscent. Embryo curved or straight.

§ Potameæ.

Flowers spicate, perfect, bractless. Perianth of 4 segments or none. Stamens 4 or 2. Carpels separate, 1-seeded; seeds campylotropous. Embryo curved.

4. Potamogeton.
Perianth segments 4. Carpels sessile.

5. Ruppia.
Perianth none. Carpels long-stipitate. Fruit in umbels.

§ Zannichelliæ.

Flowers axillary. Perianth none or hyaline. Stamen 1 with elongated filament, or of 2 or 3 connate, sessile anthers. Ovaries 2–9, 1-ovuled; ovules pendulous from the top of the cell, orthotropous.

6. Zannichellia.
Perianth none. Stamen 1, with a short filament. Carpels 2–9, a little curved. Fruit in umbels.

§ Naiæ.

Flowers monœcious or dicœcious, axillary. Perianth a hyaline envelope. Stamens of 1 sessile or 2 connate anthers. Ovaries solitary, 1-ovuled; ovules anatropous. Embryo oblong.

7. Naias.
Flowers solitary or glomerate.

§ Zostereæ.

Marine plants with long linear leaves. Flowers monœcious or dicœcious, on an enclosed spadix. Perianth none. Ovaries 1, sessile, 1-ovuled; ovules pendulous, orthotropous. Embryo straight.

8. Zostera.
Flowers monœcious. Carpels ovoid.

9. Phyllospadix.
Flowers dicœcious. Carpels heart-shaped.

1. TRIGLOCHIN, L. Sp. Pl. 338 (1753).

Marsh plants with radical, semiterete, fleshy leaves, which have membranous, often ligulate, sheaths at the base. Flowers perfect, in spikes or racemes, on long, smooth, naked scapes. Segments of the perianth 3–6, concave, the 3 inner inserted higher than the others. Stamens 3–6; anthers 2-celled, sessile or nearly so, inserted at the base of the segments and attached by the back, extrorse and with the segments deciduous. Ovaries 6, united or

rarely free, 1-celled, sometimes partially or wholly abortive; ovules solitary, basilar, erect, anatropous; style short or often wanting; stigmas as many as the ovaries, plumose. Fruit of 3–6 cylindraceous, oblong or obovoid carpels, which are distinct or connate, coriaceous, costate, when ripe separating from the base upward from a persistent central axis, the tips straight or recurved, dehiscing by a ventral suture. Seeds erect, cylindraceous or ovoid-oblong, compressed or angular. Embryo conformed to the seeds.

The carpels often appear indehiscent in the dried specimens, but they are all furnished with a distinct internal carinated suture which it may need moisture to open. The species have a rush-like appearance, and are generally found upon saline marshes near the seashore or inland, and often, also, in fresh water bogs and marshes. The long, linear leaves are usually erect, sheathing each other and the scape at the base, often partially buried in the earth.

Authors vary much as to the number of species, Kunth enumerating 16, which Micheli reduces to 9. They are widespread, inhabiting the frigid and temperate zones of both hemispheres.

Three species only occur in North America.

Carpels 3.	
Fruit linear or clavate, tapering to a subulate base.	1. *T. palustris.*
Fruit globose.	2. *T. striata.*
Carpels 6.	
Fruit oblong or ovate, obtuse at base.	3. *T. maritima.*

1. Triglochin palustris, L. Sp. Pl. 338 (1753).

Perennial. Rhizome short, oblique, throwing out radical fibres and slender, fugacious stolons. Leaves narrowly linear, shorter than the scapes, 5–12 inches long, tapering to a sharp point; ligule very short. Scapes 1–2 from the same rootstock, very slender, striate, 8–20 inches high. Racemes 5–12 inches in length; pedicels capillary, in fruit erect-appressed and 2½–3½ lines long. Perianth segments 6, greenish-yellow, ovate or roundish, in 2 series, the inner a little higher. Anthers 6, sessile, in 2 series, each under a perianth segment, large, yellow. Ovaries of 3 united carpels and as many cells and ovules; stigmas as many as the carpels, sessile, plumose. Fruit 3–3½ lines long, slender, linear or clavate, tapering into a base scarcely thicker than the pedicel and tipped with 3 short recurved points. Ripe carpels

cylindrical, tapering at base into a sharp hair-like termination, separating upwardly from the axis, and hanging suspended from its apex; central axis 3-winged. Seeds loose in the carpels, straight, the raphe marked by a purple line.

This species is readily recognized by its very slender, erect scapes, and its racemes of slender, erect, club-shaped and long capillary pedicels.

It grows in boggy places or sometimes in slightly wet grounds, or in moist sands by brooksides and brackish pools and ponds. I found it quite abundant near the Niagara Falls on the Canada side. It also occurs at various localities in Western New York, and thence westward to Montana (Belt River Canyon, Williams) and northward through Canada from New Brunswick to Alaska (Macoun). Common in the British Islands and throughout Europe and Northern Asia. (Plate XX, with a ripe fruit magnified.)

2. Triglochin striata, R. and P. Fl. Peruv. iii. 72 (1802).

T. triandra, Mx. Fl. i. 208 (1803).

Small perennials from upright or oblique, stoloniferous rootstocks. Scapes 1 or 2 from the same rhizome, more or less angular, usually not over 10 inches high, but sometimes reaching an altitude of 14 inches. Leaves slender, slightly fleshy, nearly or quite as long as the scapes and ¼-1 line in width. Flowers very small, light yellow or greenish, in spikes or racemes, with pedicels only ½-¾ line long, not increasing in fruit, the spikes 1-5 inches in length. Perianth segments 3; stamens 3, oval, large. Ovaries 3, united, crowned with long plumose stigmas. Fruit globose, ¾-1 line in diameter, appearing 3-winged when dry by the contraction of the carpels. Carpels 3, coriaceous, rounded and 3-ribbed on the back. Central column broadly 3-winged, the wings composed of a thin membrane with a strong rib-like border. Seeds loose, slightly curved, the raphe inconspicuous.

Our species belong to the form called *robustior* by Micheli. Two other smaller and more slender forms are described, named *filifolia* and *humilis*, the former from the Pacific islands and the latter from Chile.

T. striata seems to take the place of our other species in the Southern States, occurring along the seaboard from Maryland to

Louisiana in salt and fresh water marshes. A widely diffused species, native not only of the United States, but also of Brazil, Chile, many of the Pacific Islands and Southern Africa. (Plate XXI, with a ripe fruit magnified.)

3. Triglochin maritima, L. Sp. Pl. 339 (1753).

T. Mexicana, H. B. K. Nov. Gen., i. 244 (1815).

T. elata, Nutt. Gen. i. 237 (1818).

T. maritima, var. *elata*, A. Gray, Man. Ed. 2, 437 (1852).

A perennial plant with a long, unstoloniferous, often subligneous, rootstock, and a thick caudex which is usually covered with the sheaths of old leaves. Scapes stout, nearly terete, striate, 12 to 24 inches high, commonly solitary. Leaves much shorter than the scapes, fleshy, semi-cylindrical, striate, tapering gradually to a long acute or obtuse point. The leaves are usually about 1 line broad, but sometimes, as in a specimen collected in California by Dr. Bigelow, on Lieut. Whipple's expedition, reaching a width of nearly 2½ lines. Flowers very numerous, often densely crowded on the scape, and even appearing verticillate at times. The racemes often reach a length of 40 cm. or more; pedicels decurrent, 1 to 1½ lines long, slightly increasing in fruit. Perianth segments, 6, the 3 interior smaller, ovate and greenish-white, each subtending a large sessile anther. Ovaries 6, united, each 1-celled and 1-ovuled; stigmas sessile, plumose. Fruit 2½ or 3 lines long and 1½ to 2 lines thick, oblong or ovate, obtuse at the base, with 6 recurved points at the apex. Carpels 6, 3-angled, flat or slightly grooved on the back, or the dorsal edges curving upwards and sharply winged (*T. elata*, Nutt.), separating at maturity from a hexagonal axis; seeds much smaller than the thick membranous carpels, straight or slightly curved; raphe not conspicuous.

The distinctions between this species and the form *elata* of Nuttall, depending upon the presence or absence of wings on the carpels, are too inconstant to warrant even the making of a variety.

T. maritima generally occurs on salt marshes, along the seacoast and on saline grounds in the interior of the country, but is not uncommon in fresh marshes, It is widely spread on our continent from Labrador to New Jersey, and westward to Alaska and California. From Southern Mexico to Terra del Fuego, and in Europe and Asia it is equally common. (Plate XXII.)

2. SCHEUCHZERIA, L. Sp. Pl. 338 (1753).

Rush-like bog perennials with creeping rootstocks and erect, leafy stems. Leaves semiterete below and plane above, striate, furnished with a pore at the apex and a membranous, ligulate sheath at the base. Flowers small, racemose. Perianth 6-parted, regular, biserial, persistent. Stamens 6, biserial, inserted at the base of the segments; filaments elongated; anthers linear, basifixed, extrorse. Ovaries 3, rarely 4–6, separate or connate at the base, 1-celled, each cell containing one or two collateral ovules. Stigmas sessile, papillose or slightly fimbriate. Carpels 3–6, shortly connate at base, divergent, inflated, coriaceous, 1–2 seeded. Fruit a follicle, thick, flattish-oval, dehiscing laterally, containing one or two smooth seeds which have a clearly marked raphe and a thick hard testa. Seeds exalbuminous, straight or slightly curved, loose in the carpel.

Only one species is known.

1. SCHEUCHZERIA PALUSTRIS, L. Sp. Pl. 338 (1753).

Leaves 4–16 inches long, the cauline diminishing to bracts among the inflorescence. Stems one or more, rising from a long creeping rootstock, and usually clothed at the base with the remains of old leaves, 4–10 inches in height; sheaths on the radical leaves often 4 inches in length, with a ligule nearly 5 lines long. Pedicels 3–10 lines long, spreading in fruit. Flowers white, few, in a lax raceme; perianth segments acute or obtuse, membranaceous, 1-nerved, 1½ lines long, the inner ones narrower. Stamens 2½–3 lines long. Follicles 3–4 lines in length, divergent, only slightly, if at all united at the base. Seeds oval, fuscous, 2½ or 3 lines in length, with a very hard testa.

This plant occurs rather rarely in deep quaking bogs, among moss and grass, from New Brunswick to Hudson's Bay in Canada, from New England to New Jersey, and westward to Washington and California. It is also an inhabitant of Northern Europe and Asia. (Plate XXIII. with a flower magnified.)

3. LILÆA, Humb. et Bonpl. Pl. Æq. i. 221 (1808).

Annual stemless, paludose plants, with simple, slender scapes and radical leaves which are slightly dilated at the base. Flowers monœcious and dimorphous, the one sort solitary, fertile and dis-

posed among the leaves at the base, with long, thread-like styles. The other kind of flowers are monœcious, in dense spikes at the apex of slender scapes. Staminate flowers imbricated in narrow, oblong spikes; stamen of a single, 2-celled anther nearly sessile, in the axis of a white, linear, petaloid bract longer than itself. Fertile flowers imbricated in larger, conical, crowded spikes, bractless, consisting of a 1-celled, 1-ovuled ovary which is tipped with a capitate stigma; ovules anatropous. Fruit ovoid, costate, indehiscent, thick, membranaceous. Seeds oblong-conical, the raphe filiform, inconspicuous; embryo thick, conical, with an elongated cotyledon and short radicle.

Natives of western North America, Mexico and equatorial South America. One species only is known.

1. Lilæa subulata, Humb. et Bonpl. Pl. Æq. i. 222, tab. 63 (1808).

Heterostylus gramineus, Hook. Fl. Bor. Am. ii. 171 (1840).

The leaves of this species are not, as described even by so careful an observer as Micheli, "grass-like," but as Mr. S. B. Parish, of San Bernardino, Cal., writes, cylindrical, about the size of a goose quill and filled with spongy cellulose matter which causes them to become flat under pressure, and hence very deceptive in herbarium specimens. They are numerous, 8 to 12 inches high, erect, tapering to a point at the apex. Scapes 4 to 8 inches high, much shorter than the leaves and like them terete. The curious basilar flowers produce an enormously long filiform style, nearly as long as the scapes, sometimes even 8 inches, and tipped with a capitate stigma. They remind me very much of the similar flowers and styles of *Scirpus supinus* var. *Hallii* which I once found growing at Winter Pond, Winchester, Mass. Their fruit is many-ribbed, about 3 lines in length. The flowers of the spikes are smaller in size, those of the staminate flowers having abortive fertile flowers mixed with them. Micheli quotes Hieronymus as saying that the spikes are androgynous, having fertile flowers at the base, perfect in the centre and sterile at the apex, but none of our North American plants show this so far as I have seen, nor does Bonpland, in his original description, seem to have noticed such an arrangement. Ovaries in the upper flowers with a short, thick style, crowned by a papillose stigma.

In shallow water or mud. The plant was originally collected by Humboldt and Bonpland near Bogota in the United States of Colombia, but it has since been found in many other parts of South America. The writer gathered it at Buenos Aires. It occurs on Vancouver's Island (Macoun.), in San Bernardino county, Cal. (Parish), and Chihuahua, Mexico (Pringle). (Plate XXIV.)

4. POTAMOGETON, L. Sp. Pl. 126 (1753).

Leaves alternate or the uppermost opposite, often of two kinds, submerged and floating, the submerged linear and grass-like, the floating coriaceous, lanceolate, elliptical, ovate or oval. Spathes stipular, often ligulate, free or connate with the base of the leaf or the petiole, enclosing the young buds and usually soon perishing after expanding. Peduncles axillary, usually emersed. Flowers small, spicate, greenish or rufescent. Perianth segments 4, shortly unguiculate, concave, valvate in aestivation. Stamens of 4 sessile anthers, inserted on the claws of the sepals. Ovaries 4, sessile, distinct, 1-celled, 1-ovuled, attenuated into a short, erect or recurved style, or with a sessile stigma. Fruit of 4 ovoid or subglobose drupelets, the pericarp usually thin and hard or spongy. Seeds crustaceous, exalbuminous, campylotropous, with an uncinate embryo the radicular end of which is thickened. Very frequently amphibious forms of many of the floating-leaved species occur, which it is difficult to distinguish. These are dwarf, stocky forms, generally without submerged leaves, nearly always without fruit, and caused by the drying up of the water in which they grow. About the only method of deciding the species in such cases is by the occurrence of the normal form in the adjoining waters, and by the coriaceous leaves and stipules which usually retain their normal character. *P. pulcher*, *P. lonchites*, *P. heterophyllus* and *P. spathulæformis* (in England) are greatly addicted to this habit.

By *nutlet* in the following descriptions is meant the crustaceous seed freed from the pericarp.

About 65 fairly well-defined species occur in the cool waters of the temperate zones in all the continents, and the great bulk of them in northern North America, Europe and Asia. Of the 37 North American species, 14, so far as known, are confined to this country.

Stipules axillary and free from the leaf.
With floating and submerged leaves.
Submerged leaves bladeless.
Nutlets deeply pitted. 1. *P. natans.*
Nutlets not pitted. 2. *P. Oakesianus.*
Submerged leaves with a proper blade.
Submerged leaves of 2 kinds, lanceolate and oval or oblong.
Uppermost broadly oval or elliptical, lowest lanceolate. 3. P. *amplifolius.*
Uppermost lanceolate and pellucid, lowest oblong and opaque. 4. *P. pulcher.*
Submerged leaves all alike, capillary or linear-sectaceous.
1-nerved or nerveless. 27. *P. Vaseyi.*
3-nerved. 28. *P. lateralis.*
Submerged leaves all alike, linear.
Nearly the same breadth throughout, obtusely pointed, coarsely cellular-reticulated in the middle. 5. *P. Nuttallii.*
Broader at base, acute, without cellular-reticulation. 10. *P. heterophyllus.*
Submerged leaves all alike, lanceolate.
Fruit strongly embossed or dentate on the keels. 9. *P. Mexicanus.*

Keels of fruit even.
Uppermost leaves petioled, lowest sessile. 6. *alpinus.*
All petioled.
Floating leaves large, broadly elliptical, rounded or subcordate at base. 12. *P. Illinoensis.*
Floating leaves narrowly elliptical, sloping at base. 7. *P. lonchites.*
Floating leaves mostly obovate or oblanceolate, sloping at base. 8. *P. Faxoni.*
All sessile or subsessile.
Fruit only 1 line long, obscurely 3 keeled. 11. *P. spathulæformis.*

Fruit 1½ lines long, distinctly 3-keeled. 13. *P. angustifolius.*
With submerged leaves only.
Without propagating buds or glands.
Leaves with broad blades, mostly lanceolate or ovate, many nerved.
Leaves subsessile or shortly petioled, mostly acute or cuspidate. 14. *P. lucens.*
Leaves semi-amplexicaul, obtuse and cucullate at the apex. 15. *P. prælongus.*
Leaves meeting around the stem, very obtuse at the apex, not cucullate. 16. *P. perfoliatus.*
Leaves with narrow blades, linear or oblong-linear, several nerved.

Leaves oblong-linear, 5–7 nerved, obtuse at the apex. 17. *P. Mysticus.*

Leaves narrowly linear, 3-nerved, acute at the apex. 23. *P. foliosus.*
Leaves with narrow blades, capillary or setaceous, 1-nerved or nerveless.
Peduncles terminal, very long. 18. *P. confervoides.*
Peduncles axillary, short. 19. *P. Curtissii.*
With propagating buds or glands, or both.
With buds but without glands.
Leaves serrulate, 3–7-nerved. 20. *P. crispus.*
Leaves entire, with 3 principal and many fine nerves. 21. *P. zosteræfolius.*
Commonly with glands, but no buds.
Stems long branching from the base, leaves lax, plane, 3-nerved, abruptly acute or cuspidate. 22. *P. Hillii.*
Stems simple, leaves strict, revolute, 3–5-nerved, acuminate. 26. *P. rutilus.*
With both buds and glands.
Glands large and translucent, buds rare. 24. *P. obtusifolius.*
Glands small, often dull, buds common.
Leaves linear, 5–7-nerved. 25. *P. major.*
Leaves linear, 3-nerved. 29. *P. pusillus.*
Leaves capillary, 1-nerved or nerveless. 30. *P. gemmiparus.*
Stipules adnate to the leaves or petioles.
With floating and submerged leaves.
Submerged peduncles as long as the spikes, clavate, often recurved. 31. *P. diversifolius.*
Submerged peduncles none, or at most hardly a line long. 32. *P. Spirillus.*
With submerged leaves only.
Stigma broad and sessile. 33. *P. filiformis.*
Style apparent, stigma capitate.
Fruit without keels or obscurely keeled.
Leaves capillary, 1-nerved or nerveless. 34. *P. pectinatus.*
Leaves linear, 3–5-nerved. 35. *P. latifolius.*
Fruit strongly 3-keeled.
Leaves entire, 3–5-nerved. 36. *P. interruptus.*
Leaves minutely serrulate, finely many-nerved. 37. *P. Robbinsii.*

1. POTAMOGETON NATANS, L. Sp. Pl. 126 (1753).

The stems of this species grow from two to four feet in height, usually in still waters with a muddy bottom, and are simple or sparingly branched. Floating leaves thick, coriaceous, the blade ovate, oval or elliptical, 2–4 inches long and 1–2 inches broad, usually tipped with a short, abrupt point, rounded or sub-cordate at base, and with 20–30 rather strong nerves. The submerged leaves by which this species can always be distinguished from every other except *P. Oakesianus*, are phyllodia, without the

slightest sign of a lamina. I notice that they generally form a coriaceous blade at their tips when they reach the surface, showing that they are true petioles. Being attached to the lower part of the stem, they often become extremely long. I have specimens in which they are from 15 to 18 inches in length. Commonly they perish early, and are seldom seen at the fruiting period. Stipules long and acute (sometimes 4 inches), 2-keeled. Peduncles equalling the stem in thickness, and from 2 to 4 inches in length. Spikes cylindrical, sometimes upwards of 2 inches long, densely flowered and fruited. Fruit turgid, 2–2⅛ lines long and about 1¼ lines broad, scarcely keeled, narrowly obovate, slightly curved on the face; style short and facial; nutlet hard, more or less deeply pitted or impressed on the sides, with 2 grooves on the back; embryo forming an incomplete circle, the apex pointing towards the base.

The floating leaves of this species are occasionally very obtuse or acute at the apex and sloping at the base. The Atlantic coast forms generally have small coriaceous leaves, while those of Europe and our interior states are large. Very rarely floating leaves occur with as many as 40 nerves. The stipules also are sometimes obtuse and usually deciduous beneath the water. An extreme form (var. *prolixus*, Koch.), growing in deep water and strong currents, has all the parts very slender and greatly elongated. I have collected this with stems 12 feet in length, submerged leaves 21 inches long, and floating leaves lanceolate or lance-oblong and very acute.

Common in ponds and streams throughout Canada and the United States, extending into Mexico. Equally common in Europe. Occurs also in Africa and Asia. Fruits in July and August in our Northern States. (Plate XXV.)

2. Potamogeton Oakesianus, Robbins, in A. Gray, Man. ed. 5, 485 (1867).

Stems very slender, often much branched from below. Floating leaves elliptical, obtuse at the apex and rounded or slightly sub-cordate at the base, 1–2 inches long and 5–9 lines wide, with from 12 to 20 nerves and slender petioles 2–6 inches long. Submerged leaves mere capillary phyllodia, often continuing through

the flowering season. Peduncles 1–3 inches in length, commonly much thicker than the stem, mostly solitary. Spikes cylindrical, ½–1 inch long, usually not fruiting freely. Stipules hardly keeled, acute. Fruit obovate, about 1½ lines long and 1 line broad, nearly straight on the face, 3-keeled, middle keel sharp; the style apical or often sub-apical; sides of the nutlet not pitted, but sometimes slightly impressed; embryo circle incomplete, the apex pointing towards the base.

This species may readily be distinguished from *P. natans*, which it resembles, by its much smaller parts, its almost uniformly elliptical floating leaves, its delicate phyllodia, thickened peduncles, tricarinate fruit, and even-sided nutlet.

My friend, Arthur Bennett (Jour. Bot. 1890, p. 301), regards this species as the *P. Nuttallii* of Ch. and Sch. (Linnæa, ii. p. 226), which would give that name the priority, having been published in 1827. With this judgment I am unable to agree, since it appears to me that the fruit of *P. Oakesianus* does not correspond to the description or the figures given in that work. It is there said to be "oblique lenticulari-suborbicularis," but in shape it is rarely otherwise than narrowly obovate. The sides of the nutlet are said to be impressed in the middle, whereas in this species they are even. Our plant fails especially to agree with the description and figure of these authors in the embryonic curve, their seed being said to be "cochleato-convolutum, unico et paululum quod supersit anfractu," but in this case the seed is not cochleate-convolute, nor is the embryo coiled upon itself, the apex simply pointing to the base. The figure of the embryo in Linnæa as compared with the embryo of *P. Oakesianus* is quite conclusive. The fruit figured by Cham. and Schlecht. seems to me to agree so exactly with that of *P. Claytonii*, Tuck., that I have not hesitated to adopt their name for that species, as will be seen below.

The name here used was given by Dr. Robbins in honor of his old and intimate friend, William Oakes, of Ipswich, Mass.

A rather rare species, occurring in still waters, Anticosti, Canada, (Macoun), N. H. to N. J. and westward to the Adirondacks, N. Y. A doubtful form is sent from Nebraska by H. J. Webber. It is exceedingly abundant in some of the small ponds of Nantucket, where it fruits very freely. June–Aug. (Plate XXVI.)

3. Potamogeton amplifolius, Tuckerman, Am. Jour. Sci. and Arts, 2d ser. vi. 225 (1848).

Stems simple, 2-5 feet long, occasionally branching. Floating leaves thick, oval or ovate, abruptly pointed at the apex and rounded at the base, 2-4 inches long and 1¼-2 inches broad, 32-40 nerved, on petioles 3 to 5 inches in length. Submerged leaves large, the uppermost often elliptical or oval, 3-6 inches long and 1-2½ inches broad, having about the same number of nerves as the floating and sometimes shining; the lowest lanceolate, acute at each end, often as much as 8 inches long and 2 inches wide, with about 25 nerves. The lowest leaves frequently have the two sides of the blade closed and assume a recurved or falcate shape. All the submerged leaves are thin and pellucid, and are borne on short petioles. Stipules tapering to a long sharp point, 2-keeled, closely embracing the stem or spreading with age, sometimes 4 inches long. Peduncles thickening upwards, 2 to 8 inches long. Spikes thick, cylindrical, 1 to 2 inches long. Fruit, 2 to 2½ lines in length by 1¼ lines in breadth, with a thick, hard shell, turgid, obliquely obovate in shape, 3-keeled, the middle keel prominent; sides not impressed, face more or less angled; style, sub-apical; embryo slightly incurved. In the Western lakes and ponds the plants with the large oval or ovate submerged leaves are most common, and those with recurved leaves rare, while the reverse is the case in Eastern waters. Aberrant forms occur with petioles very slender and 10 or more inches in length. I have also collected occasional specimens which have at the lowest part of the stem small, opaque, oblong, long-petioled leaves similar to those found on *P. pulcher;* and, also, a very rare form which resembles *P. natans* in its upper foliage and in fruit, except the embryo. Canada from Ontario to Vancouver's Island (Macoun). United States from New England to Kentucky, and westward to Minnesota and Nebraska. An endemic species. July to Sept. (Plate XXVII, showing below one of the curved submerged leaves.)

4. Potamogeton pulcher, Tuckerm. Am. Jour. Sci. and Arts, 1st ser. xlv. 38 (1843).

Stems simple, terete, black-spotted, from 1 to 2 feet high. Floating leaves usually massed at the top on short, lateral branches,

alternate, ovate or roundish-ovate, sometimes large oval or nearly orbicular, subcordate, 2–4½ inches long and 9 lines to 3¼ inches broad, 25–33-nerved. Petioles about as thick as the stem, 2–4 inches long, and spotted like that. Submerged leaves of 2 kinds, the uppermost pellucid, lanceolate, long-acuminate, undulate, 3–8 inches in length, 6–18 lines in width, tapering at the base into a short petiole, 10 to 20 nerved, irregularly cellular-reticulated for a narrow space on each side of the midrib; the lowest near the base of the stem, fewer, much thicker, opaque, spatulate, oblong or ovate, with a rounded, tapering base, on petioles which are often broadened and ½ to 4 inches in length. The submerged leaves are usually much decayed at the time of flower and fruit, and, in order to get them in good condition, they must be gathered before the flowering period. Stipules obtuse or long-acuminate, bicarinate. Peduncles slightly thicker than the stems, 2 to 4 inches long. Spikes about an inch in length and densely fruited, when fruiting at all. Fruit tapering at top into a stout apical style, 2 lines or a little more in length and 1½ lines in breadth, thick and turgid, the back sharply 3-keeled, middle keel prominent, largely rounded at base; face angled near the centre, with a sinus below; embryo coiled 1⅓ times. Aberrant forms with coriaceous submerged leaves, and the floating ones with slender petioles, 10 or more inches long, are found in mill ponds where the water has been drained off and the pond refilled. It occurs sometimes, also, in very deep water, when the upper part lengthens into slender simple or long, branching stems, very different in appearance from the shallow water forms. It may also be found quite often in an amphibious state in pools which have become nearly dry, when it is almost without stem and exhibits coriaceous leaves only.

An endemic species, rare, and still more rarely found in fruit. The most abundant locality in which I have observed it is on the island of Nantucket, where it nearly fills some of the small ponds, and fruits quite freely.

Ponds, in Wells, Me. (Harvey), Brattleboro, Vt. (Frost), Eastern Massachusetts to Pennsylvania, Georgia, and near St. Louis, Mo. (Engelmann). June, July (Plate XXVIII).

5. Potamogeton Nuttallii, Ch. and Sch. Linnæa, ii. 226, t. vi. f. 25 (1827).

P. Pennsylvanicus, Ch. and Sch. Linn. ii. 227 (1827).

P. pumilus, Wolfg. in R. and S. Mant. iii. 354 (1827), fide. Ar. Benn. Jour. Bot. xxix. 307.

P. Claytonii, Tuckerm. Am. Jour. Sci. and Arts, 1st, ser. xlv. 38 (1843).

Stems slender, compressed, mostly simple, generally from 1 to 3 feet high, but sometimes 6 feet according to the depth of the water in which it grows. Floating leaves elliptical, sometimes obovate, obtuse at the apex, sloping at the base into a short petiole, 1½–3½ inches long and 4–12 lines wide, 12–27 nerved. These leaves sometimes number as many as 4 or 5 pairs at several inches distance from each other on the upper part of the stem. Submerged leaves linear, 2-ranked, 2–7 inches in length and 1–3 lines in width, 5-nerved, the 2 outer lateral nerves nearly marginal, the space between the two inner and the midrib evenly and coarsely cellular reticulated. In young plants the submerged leaves are often crowded close together, the internodes afterwards elongating. Stipules obtuse, hyaline, nerved, keelless. Peduncles about the thickness of the stem, 1–5 inches long. Spikes ½–1 inch long, fruiting freely. Fruit roundish-obovate, 1¼–1¾ lines long by 1–1½ lines broad, 3-keeled, middle keel sharp, the sides flat and distinctly impressed; style short, apical. Embryo coiled 1⅓ times.

Abnormal forms occur with stems bearing many short lateral branches, and with branched peduncles.

As has been stated under No. 2, I regard this species as conforming so closely to the figures and description of the fruit of *P. Nuttallii*, as given by Cham. and Sch., that I cannot question their identity. Otherwise I should have adopted their name *P. Pennsylvanicus*, given a little later in Linnæa, of which only the foliage is described. The truth seems to be that only fruit was seen in the one case and only foliage in the other, and these authors described them under different names.

So far as known, this species is peculiar to this country.

Common in ponds and streams throughout Canada, and from New England to Pennsylvania and South Carolina, and westward

to Oregon. (Plate XXIX., showing submerged leaves on the right.)

6. Potamogeton alpinus, Balbis, Misc. Bot. p. 13 (1804).
P. rufescens, Schrad. ap. Cham. Ad. Fl. Ber. p. 5 (1815).

As an illustration of the confusing extent to which synonymy has been carried in this family of plants, Mr. Bennett enumerates (Jour. Bot. xxvii., 242) 21 names given to this species by different authors.

Entire plant of a ruddy tinge, especially the leaves and spikes. This is very apparent in clear water. Stems simple or sparsely branched, somewhat compressed; internodes usually very long. Floating leaves coriaceous, spatulate or oblanceolate, obtuse, sloping into petioles 1–5 inches long, 17–21 nerved, mostly opposite, the midrib with a chain-like areolation on each side. Submerged leaves thin, semi-pellucid, the lowest sessile, the uppermost petioled, opposite under the branches and peduncles, oblong-linear or linear-lanceolate, obtuse or rarely acute, narrowing at base, 3–12 inches long and 2–9 lines wide, 7–17 nerved. Stipules broad, faintly bicarinate, with many fine nerves, pellucid on the edges, obtuse or very rarely acute. Peduncles about the thickness of the stem, 2–8 lines long, sometimes 3 or 4 or even more near the summit of the stem. Spikes cylindrical, 1–1½ inches in length, densely fruited, occasionally appearing compound. Fruit obovate, lenticular, smooth, reddish in color, about 1¼ lines long by 1 line wide, 3-keeled, middle keel sharp, almost winged, sloping on each side into obscure lateral keels; face arched and beaked by a short recurved style; apex of the embryo pointing directly to the basal end. It is stated by Dr. Robbins in Gray's Man. Ed. 5, that the fruit is "pitted when immature." In mature fruit no pit is seen. The nutlet shows smooth even sides, with a shallow depression near the base of the facial edge, and two obscure furrows on the back. This species, though common in Europe, while widely diffused is rare in our country.

Greenland; Canada from Nova Scotia to Vancouver's Island (Macoun); near Fort Yukon, Alaska (Kennicot); St. John's River, Maine (Pringle); Barnet, Vt. (Dr. Blanchard); Brattleboro, Vt. (Frost); Lake Champlain, on the Vermont and New York sides (Faxon, Morong); State line, Western Massachusetts (Robbins);

Niagara Falls, N. Y. (Morong); Delaware River, Belvidere, N. J. (Britton); Beaver River, Mich. (Hill); Vermilion Lake, Minn. (L. H. Bailey); National Park (Clifford Richardson); Utah (M. E. Jones); Oregon (Howell). Attributed by Brewer and Watson in Bot. Cal. to Montana, Colorado and California. July, August. (Plate XXX.)

7. Potamogeton lonchites, Tuckerm. Am. Jour. Sci. and Arts, 2d ser. vi. 226 (1848).

P. fluitans, Tuckerm. Am. Jour. Sci. and Arts, 2d ser. vii. 348 (1849), not Roth?

P. fluitans, Roth, Fl. Germ. i. p. 72 (1788)?

P. Americanus, Ch. and Sch. Linnæa, ii. 226, t. vi. f. 25 (1827)?

Stem slender, terete, much branched, elongated, 3 to 6 feet and sometimes more in length. Floating leaves coriaceous, usually rather thin, elliptical, pointed at both ends, 2 to 4 inches long and 6 to 14 lines wide, 17 to 24 nerved, on petioles 2 to 8 inches in length. Submerged leaves very thin and pellucid, often with an irregular cellular-reticulated space on each side of the midrib, 4 to 13 inches long by 2 to 12 lines wide, rather rounded at base or tapering gradually into a petiole 1 to 4 inches long. The stipules vary much in different plants, usually 3 or 4 inches long, but often only 1 or 2 inches long, acuminate, acute or obtuse, strongly or faintly bicarinate. Peduncles thickening upwards, 2 to 3 inches long. Spikes cylindrical, 1 to 2 inches long, densely fruited. Fruit 1¾ to 2 lines long, by 1 to 1½ lines wide, obliquely obovate, face nearly straight or rarely slightly angled or rounded, back 3-keeled, middle keel prominent, strongly rounded or often with a projecting wing just under the curve of the style, not impressed on the sides; style short, facial; embryo slightly incurved, the apex pointing slightly inside of the base.

Var. Novæboracensis, n. var.

With larger and thicker floating leaves, the blades 3 to 5½ inches long by 1¾ inches wide, 20 to 24 nerved, abruptly pointed or rarely obtuse at the apex and rounded or sloping at the base. Peduncles sometimes 4 or 5 inches long and the spikes 3 inches. The submerged leaves and fruit like those of the type. This form occurs in Lake Erie, Lake Cayuga, Niagara river, Oneida Lake, Lake Seneca, the Erie Canal near it, and in stagnant pools empty-

ing into the same lake, New York. It is the plant described by Tuckerman in Am. Jour. Sci. and Arts, l. c., under the name of "*P. fluitans*, Roth."

I have hesitated much in regard to the naming of this species, but in the present confused state of opinion concerning the status of *P. fluitans*, Roth, I can see no other method of disposing of it except to retain Tuckerman's name *lonchites* as the type and to regard the New York form as a variety. I have a large set of the English plants from Mr. Fryer, named by him "*P. fluitans*, Roth," and our typical form agrees very well with these, but as Mr. Fryer states that the English plant is never known to fruit, and he has reason to regard it as a hybrid, we cannot accept it as our *lonchites*, for that is most certainly not a hybrid, as it fruits abundantly and occurs in widely separated localities, and often where neither of the supposed parents are found. I have also numerous specimens of the continental plant called by many authors *P. fluitans*, Roth. Our variety *Novæboracensis* corresponds very closely to specimens sent me by Dr. Tiselius, collected in the river Neckar, the fruit being almost identical with that of our species, and if I could be sure that his plant is the true *fluitans*, my hesitation would be at an end, but that is in dispute. The late Prof. Caspary favored me with beautiful specimens collected in Russia, identical with those of Dr. Tiselius, and labelled "*P. fluitans*, Roth," showing the opinion of this celebrated botanist. To throw doubt upon the determination, however, there come from France plants bearing the same kind of foliage as these, but with a totally dissimilar fruit, and still called "*P. fluitans*, Roth." Considering the fact that Roth only describes the foliage of his plant, apparently never having seen the fruit, that no authentic species of his naming has ever been discovered, and that various European authors differ so widely, there is no other course left but the one here adopted. Of one thing I am certain, the plants from Dr. Tiselius and Prof. Caspary are our New York species, and that is but a larger form of our *lonchites*. I have little doubt, also, that the species the fruit of which is figured and described by Cham. and Schlecht. under the name of *P. Americanus* is our plant.

Widely diffused in this country. New Brunswick and Ontario (Macoun). New England to Florida and Texas and westward to

Washington and California. Also Mexico and Cuba. July–October. (Plate XXXI., showing a submerged leaf on the right.)

8. Potamogeton Faxoni, Morong. n. sp.

A plant collected by Mr. Edwin Faxon in the years 1880 and 1882 in Lake Champlain at Ferrisburg, Vt., which has been referred to *P. rufescens*, but is evidently quite a different species. Mr. Arthur Bennett, to whom I sent specimens, suggests in Jour. Bot. xxviii, 301, that it may be a hybrid between *P. rufescens* and *P. Nuttallii* (*Claytonii*), and also states that it greatly resembles his *P. Griffithii*, but cannot with certainty be classed under that species. If it is to be regarded as a hybrid, which may be the case, I should much rather consider it the offspring of *P. lonchites* and *P. rufescens*, as both of those species abound in the vicinity, and on the whole it more nearly resembles the former than any other North American species.

Floating leaves numerous, thick, coriaceous, mostly obovate or oblanceolate, bluntly pointed or obtuse at the apex and sloping into the petiole at base, many of them obovate like those of *rufescens*, and often strikingly like those of *spathulæformis*, 2–3½ inches long and 8–12 lines wide, 13–17 nerved, on petioles 2 to 6 inches in length. Submerged leaves oblong-lanceolate, acute or sometimes obtuse, 3–5 inches long and 6–12 lines wide, 5–13 nerved, often with an irregular areolation on each side of the midrib; on petioles ½–2 inches in length. The nerves run into the apices of the leaves, and the numerous cross veins slope slightly upward at a large angle from the midrib. Peduncles a little thicker than the stem, 2 to 5 inches long. Spikes 1 to 2 inches long, densely flowered. No fruit found.

The plant occurs in the still waters of the lake and also in the rapids of creeks emptying into the lake.

It is named in honor of Mr. Edwin Faxon, of Jamaica Plain, Mass., who was the first to collect it. (Plate XXXII).

9. Potamogeton Mexicanus, Ar. Bennett, Jour. Bot. xxv. 289 (1887).

I have seen only the fruit of this species. The following is Mr. Bennett's description of the stem and foliage: "Rootstock creeping; stems simple. Lower leaves 3–5 inches long, alternate strap-shaped, elliptical, tapering at either end; petioles 3–5 inches long.

Upper leaves 3–4 inches long, alternate (or occasionally opposite), elliptical, coriaceous, with 14-16 principal ribs, and occasionally secondary ones which fall short of the apex and anastomose with the cross-veins; areolation distinct over the whole leaf; petioles 2–6 inches long. Peduncles 2 inches long, slightly thickening upwards. Fruiting spikes 1–1½ inches long, rather few flowered."

The fruit of this species is very distinct. Drupe 2 lines long, 1½ lines wide, strongly tricarinate, the middle keel prominent, sharp and denticulate, while the lateral keels are strikingly embossed with protuberances; face slightly curved; style stout, short, facial.

Named and described from specimens in the Herbarium of the British Museum collected by Schmitz in the valley of Myrica, Mexico, and at Berlin collected by Schaffner, Aug., 1854, in a river near Chasseltepec, Mexico. (Plate XXXIII. The figure of the plant is from a drawing of Mr. Bennett.)

10. Potamogeton heterophyllus, Schreb. Spicileg. Fl. Lips. 21 (1771).

P. gramineus, Fries, Nov. Ed. 2, p. 36 (1828), not L.

P. gramineus, var. *heterophyllus*, Fries, Nov. Ed. 2, p. 35 (1828).

A very variable species. Stems slender, compressed, much-branched, from 1 to 2 feet high, usually growing in quiet water. Floating leaves coriaceous, oval or elliptical, short-pointed at the apex and rounded or sloping at the base, occasionally sub-cordate, 8 lines to 1½ inches long and 4–6 lines wide, with 10–18 nerves; petioles 1–4 inches in length. Submerged leaves pellucid, sessile, lanceolate or linear-lanceolate, acuminate or cuspidate, those of the type rather stiff, 1–3 inches long and 1–6 lines wide, with 3–7 nerves, the uppermost often petiolate. Peduncles often thickened upwards, 1–4, rarely 7, inches in length, often clustered at the top of the stem. Stipules loose, spreading, obtuse, 2-keeled, 8–12 lines long. Spike ¾–1¼ inches long, usually fruiting freely. Fruit roundish or obliquely obovate, ¾–1½ lines long by ¾–1 line broad, slightly curved or angled on the ventral side, rounded and indistinctly 3-keeled on the back, the obovate forms with an inward basal curve on the face and an indentation running into it from the centre of the sides; style short, obtuse, apical, rarely

facial; apex of the embryo nearly touching the base, pointing slightly inside of it.

The many forms of this species may be named as follows:

Forma GRAMINIFOLIUS (Fries), Morong.

var. *graminifolius*, Fries. Novit. 36 (1828).

This varies from the type in having delicate, flaccid, linear submerged leaves from 2 to 5 inches long and 1–3 lines wide. It is often found with the type and gradually runs into it.

Forma LONGIPEDUNCULATUS (Merat), Morong.

P. longipedunculatus, Merat, Fl. Paris.

This I had named forma *elongatus* until informed by Mr. Bennett that it occurs in the work of Merat under the present name. It has submerged leaves 1–2 inches long and 2–3 lines wide, sharp-pointed, the internodes naked and extremely long, frequently as much as 10 inches. Peduncles 3–6 inches long. Floating leaves ovate.

I collected this in deep water in Lake Erie, near Buffalo, and Lake Seneca, N. Y. Prof. L. H. Bailey has since obtained it in Vermilion Lake, Minn., and Mr. F. V. Coville in Chenango River, N. Y.

Forma MYRIOPHYLLUS (Robbins), Morong.

Var.? *myriophyllus*, Robbins, in A. Gray, Man. Ed. 5, p. 487 (1867).

An interesting form with long running rootstocks which send up dichotomously branching and very leafy stems. Submerged leaves delicate, about 1 inch long by 2 lines wide, 3–5 nerved, linear or the upper ones oblanceolate. Floating leaves elliptical or lance-oblong. This form often throws up very long, naked, thread like stems, which bear long-petioled floating leaves, while the submerged leaves are on short lateral branches near the base. These and the "early perishing submerged stem leaves" of which Robbins speaks are found only in a mill pond at Apponaug, R. I., the locality in which the form was first discovered, and are caused by the frequent variation in the depth of the water, now drained off and now suffered to rise. When the pond is low, the plants spring up and bear floating coriaceous leaves which are suddenly submerged by a rise in the water and very soon perish. The plant in order to meet the new conditions throws up proliferous stems which produce a new set of floating leaves.

This form is also remarkable for its tuberous rootstocks, which are very abundant.

I have collected this not only in Apponaug pond, but also in Waushakum pond, Ashland, Mass., and Lake Quinsigamond, Worcester, Mass. It occurs also in Lake Saltonstall, near New Haven, Conn. (Prof. O. D. Allen.)

Forma MINIMUS, Morong.

A very rare form, with long, almost capillary stems and internodes 3 to 4 inches in length. Submerged leaves thickly clustered on short, lateral branches, ½ to 1 inch long and scarcely ¼ line wide, acuminate, 1-nerved, some of them with the nerve obscured. Floating leaves ½ to 1½ inches long and 3 to 9 lines wide, lanceolate, oval or ovate, usually clustered at the summit of the stem.

This form I collected in Spot Pond, Stoneham, Mass., and it has also been detected in Lake Winnepesaukee, N. H., by W. F. Flint. The minute submerged leaves, clustered on short, lateral branches are quite striking.

Forma MAXIMUS Morong.

Var. *maximus*, Morong, without description, Bull. Torr. Bot. Club, xiii. 155.

All the parts greatly elongated. Stems sometimes 10 to 12 feet in length. Floating leaves often lanceolate and sharply pointed, 3 to 4 inches long and 6 to 14 lines wide. Submerged leaves 2 to 6½ inches long and 3 to 8 lines wide, 5 to 9 nerved. Specimens collected by Prof. O. D. Allen, in Lake Whitney, Conn., have large, oval, floating leaves with from 29 to 31 nerves, and submerged leaves with 13 nerves. Peduncles 2 to 4 inches long, usually much thickened upwards, often at right angles to the stem, a peculiarity which I have observed in specimens from other localities also. This form greatly resembles one sent by Dr. Tiselius from Sweden, and named by him var. *fluctuans*. It commonly occurs in swiftly flowing water, to which fact the elongation of the parts is doubtless largely owing.

Charles river, Mass., Saranac river, Adirondacks, N. Y., and Connecticut river, Deerfield, Mass. (Morong); Lake Vermilion, Minn. (L. H. Bailey); Pine Plains, N. Y. (Hoysradt); Delaware river, N. J. (Porter); flowing water, Busic river, Anticosti (Macoun).

Besides the localities of peculiar forms mentioned above, the range of the species is indicated by the following stations. Common throughout Canada from the Atlantic to the Pacific and from Maine and Vermont through New Jersey to North Carolina; Lake Huron (Macoun.); Sault Ste. Marie, Mich. (Morong); Chicago, Ill. (Babcock); Armstrong's Grove, Iowa (Cratty); Sherburne Geyser Basin, National Park (Clifford Richardson); Falcon Valley, Washington (Suksdorf); Salt Lake City, Utah (M. E. Jones); Ruby Lake, Nevada (Watson). Attributed by Brewer and Watson, Bot. Cal., to Soda Spring, near Mono Pass, Cal. (Plate XXXIV., submerged leaves on the left.)

11. POTAMOGETON SPATHULÆFORMIS (Robbins) Morong.

P. gramineus, var. (?)*spathulæformis*, Robbins in A. Gray, Man. Ed. 5, p. 487 (1867).

P. spathæformis, Tuck. in Herb.

P. varians, Morong in Herb.

Rootstock running, producing many branching stems 2–3 feet high. Floating leaves obovate, sometimes elliptical, abruptly acute at the apex and usually sloping at base, rather thin, 13–23 nerved, 1–2½ inches long and 6–13 lines wide, on slender petioles 1–4 inches in length. Submerged leaves pellucid, spatulate-oblong or linear-lanceolate, 2–4 inches long and 3–9 lines wide, 5–13 nerved, cuspidate or spinescent at the apex and sloping at base, all sessile at first, with age subsessile or even petioled. The submerged leaves are often reduced to phyllodia or forms with a very narrow blade and a long acumination at the apex and base. Peduncles often thickening upwards, 1–2 inches long. Stipules obtuse, faintly keeled, the apex slightly cucullate and splitting on pressure. Spikes large, densely flowered. Fruit like that of *heterophyllus*, about 1 line long by ¾ line broad, roundish or obliquely obovate, obscurely 3-keeled, with a curved or slightly angled face; style apical or facial; embryo with the apex nearly touching the base and pointing slightly inside of it.

This plant was discovered by Prof. E. Tuckerman as long ago as 1850 in Mystic Pond, Medford, Mass., and named *P. spathæformis* in his herbarium. Dr. Robbins obtained it afterwards from the same locality in 1856 and 1867, and published it as above cited. The present writer visited the spot several times in 1879–81 and found

it growing vigorously. No other locality for it is known in this country. It is, however, common in Cambridgeshire, England, and Mr. Fryer has kindly sent me a fine suite of specimens collected in that locality. Here it has never been observed in fruit, but it fruits, though not very freely, in England. The fruit, which is characterized from British specimens, shows a near alliance to *P. heterophyllus*, from which, however, it differs considerably in other points. Indeed, while it resembles *heterophyllus* on the one side, it exhibits a decided likeness to *P. angustifolius* on the other, and accordingly it has sometimes been ranked with the one species and sometimes with the other. Mr. Fryer, whose opinion in any matter relating to the *Potamogetons* of his district deserves great weight, is inclined to regard this species as a hybrid between *heterophyllus* and *angustifolius*, and there are strong reasons for suspecting that it may be a hybrid, such as the fact that the anthers are usually either destitute of pollen, or possess only unpotential pollen, and hence their inability to fertilize the stigmas, and the limited area of its growth. But a weighty argument against this view is the fact that neither of the supposed parents occurs in Mystic Pond, and that it should be produced in localities separated by the Atlantic ocean.

July–August. (Plate XXXV. The fruit is figured from British specimens supplied by Mr. Fryer.)

12. Potamogeton Illinoensis, Morong, Bot. Gaz. v. 50 (1880.)

Stem from a thick running rootstock, stout, much-branched above. Floating leaves opposite, numerous, thick, coriaceous, 4¼–5½ inches long, 2–3½ inches wide, the apex with a short, blunt point, rounded or sub-cordate or sometimes sloping at base, oval or broadly elliptical, 18–27-nerved. Petioles often broad and flattened, 3–4 inches long. Submerged leaves numerous, usually lanceolate, 4–8 inches long and 1–2 inches wide, 13–19-nerved, acuminate or the uppermost acute like the floating, occasionally sessile, but for the most part sloping at the base into a short, broad, flat petiole. These leaves are of a very dark green color, with a conspicuous midrib, rarely reduced to phyllodia or to leaves with a long, phyllodia-like apex and base, expanding into a narrow blade in the middle.

Stipules 2–3 inches long, obtuse, strongly bicarinate. Peduncles usually thicker than the stem, sometimes thickening upwards, 2–4 inches in length. Spikes 1–2 inches long, fruiting freely. Fruit roundish or obovate, 1½–2 lines long and 1–1½ lines broad, dorsally 3-keeled, the middle keel sharp; straight or curved on the face; style facial, short, bluntish; apex of the embryo pointing transversely inwards.

This species is evidently allied to *lucens* in habit, and with that species, *P. angustifolius*, *P. spathulæformis* and *P. heterophyllus*, forms a very natural group, but it is clearly distinct from all of them in its vigorous growth, its abundant foliage, its ample floating and submerged leaves, and its large, strongly 3-keeled fruit.

In two or three recent publications some doubts have been thrown upon the specific status of this plant, which, considering its marked individuality, are, to say the least, rather surprising. Mr. Hill, in Bull. Chicago Ac. for 1891, p. 125, says: "* * * a doubtful species at best." It seems to me not half so doubtful as many other species of good standing that might be mentioned. In fact, its peculiarities are strikingly manifest.

In A. Gray, Man. Ed. 6, it is said to be "very near *amplifolius*," a species with which it has very few characters in common. The eminent Scandinavian Potamogetonist, Dr. Tiselius, whose authority upon Northern European species no one will question, identifies it with *P. lonchites* (sub. nom. *P. fluitans*, Roth.*), but it certainly bears little resemblance to any form of that species growing in this country. Nor does it square with any of the examples of this species sent to me from Sweden by my distinguished friend. In his article he compares the floating leaves of my species with those of autumnal shoots of *P. fluitans*, and, finding them similar, rather hastily, I think, pronounces them specifically identical, but he overlooks the fact that non-fruiting autumnal growths are nearly always abnormal. Were there no other differences, the entire dissimilarity between these two species in the stipules, submerged foliage and fruit are quite sufficient to separate them widely.

Our plant was first discovered by Mr. H. N. Patterson in the

* See Nordstedt's Botaniska Notiser for 1887, p. 253.

Mississippi river bottoms at Oquawka, Ill., and sent by him to Prof. E. Tuckerman, who in turn transmitted it to Dr. Robbins, by whom it was considered as an extraordinary floating-leaved form of *P. lucens*. It has since been found by Mr. R. I. Cratty in a small pond at Armstrong's Grove, Emmet county, Iowa. Both of these gentlemen have supplied me with numerous specimens in all stages of growth, from which it has been easy to deduce the characters. I have not seen it from any other locality, though it should be expected in all the neighboring regions. Fruits in August. (Plate XXXVI.)

13. POTAMOGETON ANGUSTIFOLIUS, Berch. and Presl, Rost. p. 19 (1821), fide A. Bennett.

P. Zizii, Roth, En. Pl. Germ. i. 531 (1827).

P. heterophyllus elongatus, M. and K. Deut. Fl. i. 845 (1823).

P. lucens, var. *heterophyllus*, Fries, Nov. Ed. 2, 34 (1828).

P. lucens var. *minor*, Nolte in Hans. Ex. No. 521, British Mus., fide A. Bennett.

Stem slender, branching. The branches rise from the stem at an acute angle, occasionally at a right angle. Floating leaves coriaceous or semi-coriaceous, rarely shining on the upper surface, elliptical, pointed or abruptly acute at the apex, sloping at base, the blade 1½ to 4 inches long and 6 to 12 lines wide, with 13 to 21 nerves; petioles commonly shorter than the blade, but sometimes attaining a length of 6 inches. Submerged leaves mostly lanceolate or oblanceolate, occasionally oblong-spatulate, thin, pellucid, acute or cuspidate, sometimes acuminate, often wavy or crispy and minutely serrulate near the apex, sessile or the uppermost shortly petioled, 2–6 inches long and 3–15 lines wide, 7–17 nerved. Stipules 6–18 lines long, sometimes very broad at the base, obtuse, 2-keeled, loose and spreading as in *P. heterophyllus*.

Peduncles mostly straight and erect, stout, thicker than the stems, sometimes thickening upwards, 2½–6 inches long. Spikes 1–2 inches long, more in the habit of fruiting in Europe than in this country. Fruit obliquely obovate, 1¼–1¾ lines long and about 1 line wide, the face usually straight, occasionally a little angled, dorsally 3-keeled in the mature dried fruit; style short, blunt, facial; cotyledonary apex nearly touching and pointing directly to the end of the radicle. The fruit strongly resembles that of *P. heterophyllus*.

This species seems to be intermediate between *P. heterophyllus* and *P. lucens*. It may generally be distinguished from the former by its larger size, by floating leaves of thinner texture and more sloping at the base, by its larger, more sharply pointed and strongly undulate submerged leaves and larger fruit. From *P. lucens* it may be distinguished by its floating leaves, which are lacking in *P. lucens*, as well as by its smaller fruit and other characteristics. It usually sends up coriaceous floating leaves late in the season. It flowers freely, but seldom fruits in the United States. It commonly occurs in rather shallow and quiet waters, but is not widely diffused.

A form collected by Prof. Macoun in Methy Lake, Lat. 57° n., Canada, and which I have not seen, is thus named and described by Mr. Bennett in Jour. Bot. for May, 1891, p. 151.

"Var. *Methyensis*. Differs from any form of the type in America or Europe by the long, narrow middle leaves. The upper leaves are oval, semi-coriaceous, with long stipules, combining the habit of *longifolius*, Gay. and the *lucens* No. 607 of Herb. Fl. Ingricæ; fruit smaller, and the embryo more curved."

The type has been found in Canada in the Provinces of Ontario and Quebec (Macoun); Fresh Pond, Cambridge, Mass. (Morong); Wenham, Mass. (Faxon, Morong); Pine Plains, N. Y. (Hoysradt); Lake Cayuga, N. Y. (Dudley); Oneida and Seneca Lake, N. Y. (Morong); Delaware river, above Phillipsburg, N. J. (Porter); Pine Station, Ill. (Hill); Frankfort, Mich. (Hill); Lewis Lake, Wyoming (Clifford Richardson); Montana (Hayden Survey); Florida (Curtiss); Texas (Reverchon, Wright). Common in England and Continental Europe. (Plate XXXVII.)

14. Potamogeton lucens, L. Sp. Pl. 126 (1753).

Stem thick, branching below and often with masses of short leafy branches at the summit. Destitute of propagating buds or glands. Leaves all submerged, elliptical or lanceolate, uppermost often oval, rounded at both ends and merely mucronate, usually acute or acuminate and cuspidate, sessile or short petioled, 2½–8 inches long and 8–20 lines wide. The nerves are commonly 13, but sometimes fewer, and the tips frequently serrulate. They are rarely shining, though the name would imply otherwise. Stipules 1–3 inches long, obtuse, bicarinate, commonly loose and spread-

ing, sometimes very broad. Peduncles 3–6 inches long, scarcely thickening upwards. Spikes 2–2½ inches long, very thick cylindrical, fruiting freely late in the season.

Fruit about 1½ lines long and 1¼ lines broad, roundish; keels small, often obscure; face usually with a slight inward curve at the base; style nearly apical; apex of embryo pointing transversely inwards, but the curve less than in No. 12.

The typical form of our species approaches most nearly to the European form called var. *ovalifolius*, M. and K., as the uppermost leaves are generally oval or ovate in outline. Those remarkable forms, so common in Europe, and known as var. *cornutus*, Presl., var. *longifolius*, Gay, and var. *acuminatus*, *Schum.* never occur in our country, so far as I am aware, but they are approached by the submerged foliage of *P. Illinoensis*.*

Var. Connecticutensis, Robbins, in A. Gray, Man. Ed. 5. 488 (1867.)

This seems to be a good variety, but very rare. As stated by Dr. Robbins, the stems are flexuous, the leaves acuminate, and the fruit larger than in the type (1¾–2 lines long and about 1½ lines wide), distinctly tricarinate and with a facial style. It has been found only in Saltonstall's Pond, East Haven, Conn. (Robbins), and Pine Plains, N. Y. (Hoysradt). Forms resembling this were obtained by E. Faxon in Lake Dunmore, Vermont, but without fruit.

The typical *lucens* is not very common in this country. It occurs rarely in Nova Scotia and Ontario (Macoun); Fresh Pond, Cambridge, Mass. (Morong); Lakes Cayuga, Onondaga and Oneida, N. Y. (Dudley, Morong.); Pine Station, Indiana (Hill). Attributed to Fla. by Chapman (Chap. Fl.); and to Mission Dolores, Cal. by Brewer and Watson (Fl. Cal). It has also been collected by Pringle in the State of Michoacan, Mex. (No. 3327, wrongly named *P. Zizii*). Cuba (Wright). Common throughout Europe, Asiatic Russia, and other parts of Asia. (Plate XXXVIII.)

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*Mr. A. Bennett in his recently published list of the *Potamogetons* in the Vienna Herbarium (Ann. der. K. K. Naturhist. Hoffmus. for 1892, p. 290), notes in that collection a specimen of *P. longifolius*, Gay, gathered in Oregon by Dr. Lyall.

15. POTAMOGETON PRAELONGUS, Wulf. in Röm. Arch. iii. 331 (1805).

P. flexuosus, Schleich. and Wredow, Meklenb. Fl. (1807).

P. flexicaulis, Dethard, in Strelitz. Anz. 1809. n. 50.

Stem white, flexuous, flattened, much branched, growing in deep water, sometimes 6 to 8 feet in length. Leaves all submerged, oblong or oblong-lanceolate, obtuse and cucullate at the apex, splitting on pressure, semi-amplexicaul, of a bright green color. They are from 2 to 12 inches in length, and from ½ to 1¼ inches wide, with only 3 or 5 main and from 7 to 17 finer nerves, sometimes with a narrow reticulated space on each side of the midrib. Stipules white, scarious, obtuse and commonly closely embracing the stem. Abnormal specimens with spreading stipules 2–3 inches long have been collected in Maine by Miss Kate Furbish. Peduncles from 3 to 15 inches and occasionally as much as 20 inches long, erect, straight, about as thick as the stem, and often very numerous. Spikes 1–2 inches long, thick, cylindrical, densely fruiting. Fruit dark green, obliquely obovate, 2–2½ lines long and 1½–2 lines wide; the back much rounded, often with the upper curve nearly as high as the style. Middle keel sharp and prominent, sloping on the sides to rather obscure lateral keels; face straight or nearly so; style short, obtuse, facial; apex of embryo pointing directly to the base.

This species fruits in our country in June and July, and usually withdraws its stems beneath the water as soon as the fruit is set. Hence the difficulty of obtaining good fruit unless dredging is resorted to.

Deep water, lakes and ponds, Nova Scotia, New Brunswick, Ontario and Vancouver's Island (Macoun's Cat.); Shelburne Pond Vt. (Pringle); Wenham and Fresh Ponds, Mass. (Morong); Bantam Lake, Litchfield, Conn. (Morong); Lake Salstontall, Conn. (Prof. J. A. Allen); Canaan, Conn. (Robbins); Budd's Lake, N. J. (Porter); Lake Canandaigua, N. Y. (Morong); Maltowah Lake and Chenango River, N. Y. (Coville); Frankfort, Mich. (Hill); along the Great Lakes to Lake Superior (Robbins); Vermilion Lake, Minn. (L. H. Bailey); Iowa (Arthur's Cat.); National Park (Clifford Richardson); Sierra Co., Cal. (Brew. and Wats. Bot. Cal.). (Plate XXXIX.)

16. Potamogeton perfoliatus, L. Sp. Pl. 126 (1753).

Stems slender, from running rootstocks which throw up many shoots, much branched, often with many short lateral branches along the main stem. Leaves very variable in shape and size, mostly ovate or rounded, sometimes lanceolate, usually obtuse, sometimes acute at the apex, amplexicaul and cordate at base, meeting around the stem. They are never cucullate, as in the preceding species, and never known to produce propagating buds or glands. They are often crowded upon the stem, but more commonly separated at a considerable distance, generally alternate, but opposite under the nodes of the branches. The typical European forms have large rounded or ovate leaves about 2 inches long by 1½ inches broad, varying from this to narrow and elongated forms ½–1½ inches long and 4–15 lines in width, and 13–27-nerved. The full type is rather rare in this country, the greater part of our forms being small leaved, and west of New England running into the form known as Var. *lanceolatus*, Robbins. As found here the typical plant has leaves varying from 5 to 15 lines long and from 3 to 12 lines wide, usually obtuse and minutely serrulate near the apex. Peduncles 1¼ inches long, about the same thickness as the stem, usually erect or slightly spreading, running in the axils of the leaves for a long distance along the upper part of the stem. Spikes 8–12 lines long, often flowering and fruiting under water. Fruit obliquely obovate, 1¼–1½ lines long by 1 line or a little more in breadth, obscurely tricarinate on the back, the face a little curved outwardly towards the top, the sides with a shallow indentation which runs into the face; style nearly facial; embryo slightly incurved or with its apex pointing directly towards the base.

Var. Richardsonii, Ar. Bennett, Jour. Bot. xxvii. 25 (1889).
Var. *lanceolatus*, Robbins, in A. Gray, Man. Ed. 5, 488 (1867).

Mr. Bennett notes that the name of Robbins is preoccupied by a different form of Blytt in Norges Flora (1861), and proposes the present name in honor of the Arctic explorer, Dr. Richardson, "who seems to have been the first to point out the difference from the European forms in the 'Appendix' (Botany) to Franklin's Expedition."

Leaves of this variety lanceolate, from 1 to 4¼ inches long and 4–8 lines wide at the broadened amplexicaul base, often curving inwards towards the apex, and from 13 to 23-nerved. Leaves from North Hero, Lake Champlain (Morong), and Sault Ste. Marie, St. Mary's River, Mich. (Hill), measuring 4¼ inches in length, are the longest that I have ever seen. The fruit is somewhat larger than in the type, measuring about 1¾ lines long by 1¼ lines wide.

Forms found in Wenham Pond, Mass., greatly resemble *P. nitens*, Webber, of Europe, and are considered to be this species by Dr. Tiselius. They also bear a strong resemblance to *P. perfoliatus*, var. *Jacksoni*, Nees, of England, which is regarded as a form of *nitens* by Prof. Babington. They have oblong leaves 1–1½ inches long and 4–9 lines wide, obtuse, 7–13-nerved, not serrulate, semi-amplexicaul, with very slender, laterally much-branched stems.

Common in Canada from Nova Scotia to Ontario (Macoun). In the United States it occurs in nearly all parts of the country from Maine to Florida, and west to the Pacific. The variety occurs in Ontario, Canada, and thence westward, and from Lake Champlain, Eastern New York and Delaware westward to Oregon and California, being the most common Western form. In still, shallow or deep water. July–September. (Plate XL. Var. *Richardsonii* is figured on the right).

17. Potamogeton Mysticus, Morong, Bot. Gaz. 5, 50 (1880).

Whole plant very slender and delicate. Stems from a creeping rootstock which throws up many shoots, irregularly branching above, nearly filiform, terete, 1–3 feet high. Leaves all submerged, scattered, oblong-linear, 1–1½ inches long and 1–3 lines wide, 5–7-nerved, obtuse and rarely with minute serrulations near the apex, abruptly narrowing at the base and sessile or partly clasping. Stipules obtuse, about 6 lines long, hyaline, with many fine nerves, mostly deciduous, but sometimes persistent and closely sheathing the stem. Spikes few, capitate, 4–6-flowered, on erect peduncles from 1 to 2 inches in length. No ripe fruit has ever been found, but one or two immature drupes indicate that it is obovate, minute, scarcely ¾ of a line long by ½ a line broad, obscurely 3-keeled on the back, a little beaked by the slender recurved style.

Since I obtained this from Mystic Pond, Medford, Mass., in 1879, I have visited the locality for several years in succession, and, though I have always found the plant growing vigorously, yet it has shown no signs of prefecting fruit. In the year 1887 I found it growing in Miacomet Pond, Nantucket, under water about 3 feet deep, but it was entirely without flowers or fruit.

It is closely allied to *P. perfoliatus* in habit, with which it is associated in growth, but very unlike that in foliage, and scarcely one-third as stout in any of its parts. August–September (Plate XLI).

18. Potamogeton confervoides, Reichb. Icon. Fl. Germ. et. Helv. vii. 13 (1845).

P. trichoides, A. Gray, Man. ed. 1 p. 457 (1848). Tuckerm. Am. Jour. Art and Sci. 2 ser. vii, 358 (1849), not Cham.

P. Tuckermani, Robbins in A. Gray, Man. Ed. 2. 434 (1856).

Mr. Bennett states in Jour. Bot. xxviii. 92, that he has seen a specimen of this species in Gay's Herb. at Kew under Reichenbach's name, and that it is undoubtedly the same as *P. Tuckermani*, Robb. The description of Reichenbach corresponds very well to our plant. There is here a good illustration of the danger of determining names without corroborating specimens, for Tuckerman, one of the most minute and careful observers, says in his paper upon *P. trichoides:* "I have seen no specimens of the European plant, but Chamisso's minute description, and his figure of the fruit leave little or no doubt of the identity of ours with it," and yet he was mistaken.

Stem from a creeping rootstock, slender, terete, much-branched, the upper branches repeatedly dichotomous, 6–18 inches high. Leaves very delicate, flat, setaceous, 1–2½ inches long, the broadest scarcely ¼ line wide, tapering to a long hair-like point, 1–3-nerved, often with a few cross ribs or coarse reticulations, of a bright green color, a little yellowish tinted. Stipules delicate, obtuse, 2–3 lines long. Peduncles terminal, 2–8 inches long, straight and erect, somewhat thickened upwards, sometimes with a short lateral branch bearing a spike. Spikes capitate, 3 or 4 lines long; Fruit thick with a shell roundish-obovate, 1–1½ lines long and about as wide; back sometimes a little angular or sinuate, 3-keeled, the middle keel sharp and prominent; face notched near the base; sides impressed with a shallow indentation which runs into the

notch of the face; style short, apical; embryo circle complete, the apex nearly touching the base a little inside of its end.

A rare species growing in the shallow water of ponds. Round Pond, York, Me. (Fernald); Franconia Notch, N. H. and a small pond on Mt. Willey, 3,000 feet alt. (Faxon); Uxbridge, Mass. (Robbins, Morong); New York (Torrey); common in N. J.; Great Lake, Carbon Co., Pa. (Porter). (Plate XLII.)

19. Potamogeton Curtissii, Morong, Bull. Torr. Bot. Club, xiii. 145 (1886).

Stems simple or branched, capillary, a foot or more in height, the internodes long and naked. Leaves 6–17 lines long, almost setaceous, many of them less than ¼ of a line and none ½ a line broad, tapering to a long, hair-like point, the midrib with 2 delicate nerves or a loosely-reticulated space on each side of it. Stipules hyaline, obtuse, 3 or 4 lines long, deciduous. Peduncles 3–6 lines long, somewhat clavate, erect, axillary and racemosely disposed, 5 or more of them at intervals of one or two inches along the upper part of the stem. Spikes capitate, 2 or 3 lines long, 3–6-flowered. Fruit not seen.

Collected by Mr. A. H. Curtiss in Blackwater River, and a "tidal creek" in Northwest Florida, May and June, 1886, the only known locality for it. (Plate XLIII. A magnified leaf is figured on the right.)

20. Potamogeton crispus, L. Sp. Pl. 126 (1753).

Stems branching, compressed. Leaves 2-ranked, linear-oblong or linear-oblanceolate, sloping at base, sessile or semi-amplexicaul, obtuse, serrulate, crisp, ¾–4 inches long and 3–7 lines wide, 3–7-nerved, the midrib often compound and the outer nerves very near the margin. Stipules small, scarious, obtuse, early perishing. Peduncles 1–2 lines long, frequently recurved when in fruit and sometimes very numerous. Spikes about half an inch long, and looking very bristly with the long-beaked drupes when in fruit. Fruit ovate, about 1½ lines long and 1 line or a little more in width, having 3 rounded keels on the back, the middle one with a small projecting tooth near the base, a slightly curved face, and a curved facial style nearly as long as the drupe; the shell thick and corky, containing a small embryo, the apex of which points directly towards the end of the radicle.

This species in our country propagates itself mainly by winter buds, of which there are two kinds. The rarer kind is spicular in form, being simply a fragment of the stem, shrunken or sharpened at the ends, with 2–6 buds upon it in the axils of the decayed leaves. The more common form is a thick, rigid body composed of the ends of the branches or stems, in which the upper portion is swollen, hardened and surrounded by the bases of the leaves, which are also much enlarged and indurated, and reduced to a triangular shape, several buds being left in the axils. The lower end becomes sharpened and is so easily detached that a mere jar shakes it off the stem. The whole bud looks like a burr, and when separated from the stem floats away bottom side up or sinks into the mud. The new plant is formed by the development of one of the buds which throws out roots as it grows. It occurs in fresh and brackish or tide water. Confined to a strip along the Atlantic coast from Arlington, Mass., to James City, Virginia. It also runs inland in fresh water as far as Lancaster, near the Susquehanna River, Pa. (Porter), and the Lakes Keuta and Seneca, in the centre of New York. Introduced from Europe, where it is common.* (Plate XLIV. The two kinds of propagating buds are shown on the left.)

21. POTAMOGETON ZOSTERÆFOLIUS, Schum. Enum. Pl. Saell. 50, 168 (1801).

P. complanatus, Willd. Mag. Berl. Fl. iii. 248 (1809).

P. compressus, Fries, Nov. Ed. 2. 44 (1828), not L. Herb.

P. cuspidatus, Schrad. in Smith's Eng. Bot. i. 235 (1828).

Stem very much flattened, sometimes winged, widely branching. Leaves linear, obtuse and mucronate or shortly acute, with 3 principal nerves and many fine ones, the midrib often compound, 2–12 inches long and 1–2 inches wide. Stipules scarious, obtuse, finely nerved, soon perishing. Peduncles 1½–4 inches long; spikes cylindrical, about ½ inch long, 12–15 flowered. Fruit obovate, with a broad base, 1¾–2 lines long and 1¼–1½ lines wide, 3-keeled on the back, lateral keels somewhat obscure, the

* Probably of recent introduction, as it seems not to have been known to the older botanists, Rafinesque, Michaux, Pursh, Nuttall, Barton and others who collected extensively in the region where it grows during the early part of this century.

middle one often slightly toothed or undulate and with a projection at the base; face arched, beaked with a short, recurved style; embryo slightly incurved.

The propagating buds of this species are very unlike those of No. 20, consisting only of the ordinary terminal leaf bud which drops off near the end of the branch, sinks to the bottom and rests in the mud during the winter. It is, however, a very common source of propagation.

An elegant plant, with bright smooth leaves in fascicles at the summits of the branches. It may be distinguished from other North American species, and from *Heteranthera graminea* with flowerless forms of which it is sometimes confounded, by the numerous fine nerves on the leaves.

In still or slowly moving water in Northern regions. New Brunswick to the Saskatchewan, Canada (Macoun); Vermont to New Jersey and westward to Iowa, Lake Superior and Oregon (Hall, No. 491, fide Brew. and Wats. Bot. Cal.). Common in Europe. July, August. (Plate XLV.)

22. Potamogeton Hillii, Morong, Bot. Gaz. vi. p. 290 (1881).

Stems slightly compressed, slender, widely branching, 1–2 feet in height. Leaves linear, acute or abruptly acute and cuspidate, often almost aristate, 1–2¼ inches long and ½–1¼ lines wide, 3-nerved, the lateral nerves delicate and nearer the margins than the midrib, the midrib below often compound. Stipules whitish, many-nerved, obtuse, 3–5 lines in length. Peduncles about half an inch long, erect or slightly recurved, more or less clavate. Spikes capitate, 3–6 fruited. Fruit obliquely obovate, obtuse at the base, 1¾–2 lines long by 1–1¼ lines broad, tricarinate on the back, the middle keel sharp and more or less undulate, flat on the sides, the face slightly arched; style nearly facial, short, recurved; embryo apex pointing transversely inwards.

There are two forms of this species, the one biglandular at the base of the leaves, and the other glandless. I found it growing in the small pot ponds of Manistee, Mich., each pond having its own form and apparently never mixing. In general appearance similar to the large forms of *P. foliosus*, but allied by its peduncles, spikes and fruit to *P. obtusifolius* and *P. zosteræfolius*, and still more

closely to the European *P. acutifolius*, Link, to which in these respects it bears a close resemblance.

A rare species growing in pools and ponds, and so far as known, peculiar to the United States. Lake Cayuga and near Freeville, N. Y. (Dudley); Pine Plains, N. Y. (Hoysradt); Manistee, Mich. (Hill, Morong); Ashtabula, Ohio (Hill). (Plate XLVI.)

23. Potamogeton foliosus, Raf. Med. Rep. 2d Hex. v. 354 (1808).
P. gramineus ? Mx. Fl. i. 102 (1803), not L.
P. pauciflorus, Pursh, Fl. i. 121 (1814).

Pursh's name, which this species has borne so long, must be surrendered, not only because it had been antedated by that of Rafinesque, but also because it had been used by Lamark as long ago as 1778 (Fl. Franc. iii. 209, No. 798) as a synonym of *P. densus*, L.

A variable species peculiar to North America. Stems flattened, much-branched, 1 to 3 feet high. Leaves 1–2 inches long and ½–1 line wide, acute, 3-nerved, not glandular at the base. Very delicate forms are found, especially near the Atlantic coast, which are scarcely more than 6 inches in height, the stems filiform, the leaves not over 8 lines long by ¼ line wide, the lateral nerves obscure or even obsolete. From this it rises into the coarser forms which are more common inland and towards the west. Stipules white, hyaline, obtuse, sometimes acute, 6–10 lines long. Peduncles more or less club-shaped, erect, about ½ inch long. Spikes about 4-flowered. Fruit impressed with a shallow pit on each side when young, but even when fully mature, lenticular, or nearly orbicular, ¾–1 line in diameter; 3-keeled on the back, the middle keel winged, sinuate-dentate, often with projecting shoulders or teeth at each end; face strongly angled or arched, sharp or alate, often with a sharp, projecting tooth at the base; style nearly apical, straight or recurved; embryo curve complete, the apex nearly touching the basal end. The fruit rarely approaches that of *P. pusillus*, being obliquely obovate, about 1 line long and ¾ line wide, the wing on the middle keel narrow and not dentate, but still it may always be distinguished by being more or less crested. This species is also in very rare cases furnished with reproductive buds and minute glands like those of *pusillus*.

Var. Niagarensis (Tuckerman) A. Gray, Man. ed. 2. 435 (1856).
P. Niagarensis, Tuckerm. Am. Jour. Sci. 2 ser. vii. 354 (1849).

Larger than the type, stems 2–3 feet in height, leaves sometimes over 3 inches in length and 1 line wide, 3–5-nerved. Stipules longer and occasionally acute. Spikes 8–12 flowered. Mainly distinguished by its large size. This form, which is the coarsest in the species, was originally discovered by Prof. Tuckerman in the rapids above Niagara Falls, and was considered by him a good species, but it seems to me too near *foliosus* to take specific rank. For many years it seemed to have disappeared from the original locality until the writer found it in abundance in a sluice way between the Falls and the village on the American banks. It has recently been collected by Mr. F. V. Coville in the United States expedition to Death Valley, California.

Var. Californicus, Morong, Bot. Gaz. x. 254 (1885).

This form is distinguished by its bushy, vigorous growth and large thick stem which is strongly flattened and sometimes winged, often ½ line wide. Many stems, thickly clustered, rise from the roots. Leaves not so long or broad as in the preceeding variety, but with a dilated mid-rib, reminding one of *P. obtusifolius*, and frequently 5-nerved at the base. Peduncles 4–6 lines long, erect, clavate, flattened. Spikes often ripening 12 strongly marked fruit. Collected in San Bernardino county, Cal. by the Parish Brothers, and by D. Cleveland at San Diego.

The species has a wide range, occurring in Canada from New Brunswick to British Columbia (Macoun); New England to Florida and New Mexico and westward to Oregon and California. July-September. (Plate XLVII. Two common forms of the fruit are figured.)

24. Potamogeton obtusifolius, M. and K. Deut. Fl. i. 855 (1823).
P. gramineus, Sowerby, Eng. Bot. iii. t. 2253 (1794), not L.
P. compressus, Wahl. Fl. Suec. i. p. 107 (1824), not L.

Stem usually slender, compressed, branching widely, especially towards the summit. Leaves linear, 2–3 inches long and ½–2 lines wide, obtuse, often mucronate, usually 3-nerved, sometimes 5- and rarely 7-nerved, biglandular at base, the glands large and translucent, the midrib broad and frequently compound. Stipules white or scarious, many-nerved, obtuse, 6–9 lines long, often as long as or longer than the internodes. Peduncles numerous, ½–

1½ inches long, slender, erect, rising from the axils of the branches. Spikes 3–4 lines long, ovate, continuous, 5–8 flowered. Fruit obliquely obovate, about 1½ lines long and 1 line wide, 3-keeled, middle keel distinct; face straight or nearly so; sides with a slight impression which runs into the face; style short, blunt, nearly facial; embryo with the apex pointing a little inside of the base. In North American forms the fruit is slightly longer and narrower, and the embryo more incurved than in the European plant. Rarely producing propagating buds.

Non-fruiting specimens of *P. major* are liable to be confounded with this species. For the distinctions see under that species.

Not very common in this country. Ponds and still waters. Quebec and Methy River, Lat. 57° N. Canada (Macoun); Barton, Vt. (Robbins); Granby, Mass. (Tuckerman); Pleasant Pond, Wenham, Mass. (Morong); Worcester and Natick, Mass. (Morong); Pine Plains, N. Y. (Hoysradt); Spencer, N. Y. (Dudley); Easton and Susquehanna River, Pa. (Porter); Lake Superior (Robbins); Vermilion Lake, Minn. (L. H. Bailey); Sherburne Geyer Basin, Wyoming (Clifford Richardson). July–August (Plate XLVIII.)

25. POTAMOGETON MAJOR (Fries) Morong.

P. pusillus L. var. *major*, Fries, Nov. 48 (1828).

P. Friesii, Ruprecht in Beit. Pf. de Russ. R. iv. 43 (1845).

P. compressus, Sm. Eng. Bot. iii. t. 418 (1794). Reich. Ic. Fl. Germ. vii. 15 (1845), not L.

The name *compresus*, which is used by some authors must be discarded, because it is applied by Linnæus himself to several species. *P. mucronatus*, Schrad., is also uncertain, according to Mr. Bennett, who has carefully studied the synonymy of this species. (See Journ. Bot. May, 1891, p. 150). Fries' varietal name, so far as I can see, is the earliest name applied to it on which we can depend.

Stems compressed, 2–4 feet high, branching, Leaves 1½–2½ inches long, about 1 line wide, shortly acute or obtuse and cuspidate, usually 5-nerved, but rarely 7-nerved, biglandular at base, the glands small, often dull. Intermediate forms between this and *P. pusillus* often occur in this country in which most of the leaves

are 3-nerved or 5-nerved at the base only. Stipules white, hyaline, finely nerved, obtuse or acute, 6–12 lines long. Peduncles 1–1½ inches long, often thicker than the stem and sometimes thickening upwards. Spikes when developed interrupted. Fruit quite similar to that of *P. pusillus*, but I find it always with a recurved style, generally with a shallow pit on the sides and with the apex of the embryo pointing almost directly towards the basal end. The propagating buds are similar to those of *P. pusillus*, but not so common.

This species may generally be distinguished from *pusillus* in its various forms by its larger leaves, larger and more flattened stems and its more elongated and less branching habit, but the two run together so closely that at times it is difficult to separate them. It is considered by some authors as intermediate between *P. pusillus* and *P. obtusifolius*, and when not in fruit it may be confounded with the latter, but as a rule the glands are smaller and duller in tint than in that, and the leaves shorter. *P. obtusifolius*, too, is much more bushy in habit, sometimes even spreading out in fan-shape, and it is extremely rare that its leaves have more than 3 nerves.

The species rare in the United States. New Brunswick, Ontario and British Columbia (Macoun); Lake Champlain, Vt. (Faxon); Lake Seneca, N. Y., abundant (Morong); Wisconsin (Lapham); Michigan (Hill); Minnesota (Cratty). July–September. (Plate XLIX. A leaf magnified is shown on the left.)

26. Potamogeton rutilus, Wolfg. in R. and S. Mant. iii. 362 (1827).

P. cæspitosus, Nolte, fide Reich. Ic. vii. 15.

Stems very slender, 8 to 24 inches in height, compressed; roots finely fibrous, sending up many stems, but each stem simple or nearly so. I find them occasionally rising from a bit of stem or hybernaculum, showing that the species is sometimes, at least, propagated in this way, but usually without propagating buds. Leaves 1 to 1½ inches long and ¼ to ½ a line broad, acute or acuminate, strict, nearly erect, 3–5 nerved, revolute, nerves prominent beneath, the midrib compound, especially at the base, where it often divides into 2 and even 4 strongly marked nerves, often

biglandular at base and bright green in color. Stipules acute, 6–10 lines long, often longer than the internodes and hiding the bases of the leaves above, persistent, becoming white and fibrous with age. Peduncles 6–18 lines long, scarcely thicker than the stems. Spikes 3–5 lines long, usually continuous, but sometimes interrupted. Fruit obliquely obovate, ¾–1 line long by ½–¾ line wide, keels obscure, or the back showing only 2 small grooves; face obtusely angled towards the base; apex of drupe sloping into a short, facial, recurved style; embryo circle not complete, the apex pointing a little inside of the basal end. Resembling *pusillus*, especially those occasional forms of that species which have acute and somewhat revolute leaves; but its strict, almost or quite erect leaves with long very sharp acuminate points, prominent nerves, and long, persistent, acute stipules well distinguish it.

A rare species in this country. Anticosti, at the mouth of the Nipigon River, near Red Rock, Lake Superior and James Bay, Canada (Macoun). Found by Prof. L. H. Bailey in flower July 24, 1886, in Vermilion Lake, Minn., (no. B. 394). (Plate L.)

27. Potamogeton Vaseyi, Robbins, in A. Gray. Man. Ed. 5, 485 (1867).

Bearing floating leaves on the fertile stems only. Very delicate, stems filiform, widely branching from below and with many short lateral branches above, 1–1½ feet in height. The emersed fertile forms in shallow water, near shore, and the more common sterile submerged forms in water from 6 to 8 feet in depth. Floating leaves coriaceous, in 1–4 opposite pairs at the top of the stem, the blades obovate, 4–5 lines long by 2–3 lines wide, with 5–9 nerves deeply impressed beneath, sloping at base into petioles 3–4 lines long. Submerged leaves almost capillary, nerveless or 1-nerved, tapering to the fineness of a hair, 1–1½ inches in length. The leaves frequently biglandular at base. Stipules white, delicate, many nerved, acute or obtuse, 2–3 lines long. Peduncles 3–6 inches long, spreading or recurved, thickening in fruit. Spikes 2–3 lines long, often interrupted. Fruit roundish-obovate, about 1 line long and nearly as broad, 3-keeled, middle keel rounded; face arched above and incurved below, tipped with a rather long straight or recurved style; sides even or impressed with a shallow

pit. The spikes ripen from 2 to 6 fruit, most of the flowers being abortive. This species, especially in the submerged plant, is furnished with delicate reproductive buds which are formed at the ends of short lateral branches and by which it seems to be mainly propagated. The internodes are usually long and naked.

Var. LATIFOLIUS, Morong.

A rare form with submerged leaves 1/3–3/4 of a line wide, abruptly acute and 1–3-nerved. The glands more conspicuous than in the type. This was collected by Dr. Beardsley at Painesville, Ohio.

A rare endemic species confined to Canada and the Northern United States.

The original plant was collected by Dr. George Vasey near Ringwood, Ohio. It has since been found at Ottawa (Fletcher), and on the Great Plains, Canada (Macoun); Barnet, Vt. (Dr. Blanchard); Lake Saltonstall, Conn. (O. D. Allen); Spot Pond, Stoneham, Mass., Lake Quinsigamond, Worcester, Mass. and Greenwood Lake, N. Y. (Morong). (Plate LI.)

28. POTAMOGETOM LATERALIS, Morong, Bot. Gaz. v. 51 (1880).

Stems filiform, much-branched, internodes usually long and naked. Floating leaves coriaceous, elliptical, obtuse at the apex and sloping at base into petioles 3–10 lines long, blades 4 or 5 lines long by 1–2 lines broad, with 5–7 nerves deeply impressed beneath, usually in 1–3 opposite pairs which stand at right angles to the stem, found only on sterile shoots. Submerged leaves very narrow, linear, acute, 1–3 inches long and 1/4–1/2 line wide, 1–3-nerved, the lateral nerves very delicate and obscure, the midrib prominent and often with fine veins or cellular reticulations on each side of it, biglandular at base, but the glands few, small and often obsolete. Stipules small, hyaline, many-nerved, obtuse, deciduous. Peduncles as well as the floating leaves with a peculiar lateral appearance, widely spreading at maturity, sometimes even recurved, thickened when in fruit, 4–15 lines in length. Spikes capitate or often interrupted, 3–4-flowered. Fruit obliquely obovate, about 1 line long by 3/4 line broad, lenticular, the back much curved and 2-grooved, the face arched and surmounted by the nearly sessile stigma; embryo oval in its curve, the apex

nearly touching the point of the base. The plant is scantily furnished with reproductive buds like those of *P. pusillus*. Proliferous shoots at the summit of the stem and on the upper branches, above the floating leaves, appear late in the season just as the plants are beginning to decay, a very peculiar habit.

In slowly-moving water, 3–4 feet deep, in dense masses, Charles River, Dedham, Mass. (Faxon, Morong); Salisbury, Conn. (Robbins); Hemlock Lake, Livingstone Co. N. Y., and Bear Lake, Mich. (Hill). July, August. (Plate LII. Sterile and fertile branches.)

29. Potamogeton pusillus, L. Sp. Pl. 127 (1753).

A variable species with filiform, branching stems from 6 inches to 2 feet in height. Leaves all submerged, linear, obtuse and mucronate or acute at the apex, 1–3-nerved, biglandular at base, rarely glandless, 1–3 inches long and ¼–¾ line broad. The typical form (var. *vulgaris*. Fries. Nov. p. 49), has leaves 3-nerved, from a little less than ½ to ¾ line broad, obtuse or shortly acute, and not unfrequently cellular-reticulate between the midrib and the lateral nerves. The leaves are sometimes revolute and slightly ridged in the middle, resembling in this respect those of *P. rutilus*. Another common form has the leaves about ¼ line wide, almost setaceous, 1–3-nerved, the lateral nerves obscure or obsolete, acute (var. *tenuissimus*, M. and K. Deut. Fl. i. 857. *P. gracilis*, Fries, Nov. p. 50).

Both of these forms are occasionally provided with reproductive buds.

Stipules short, hyaline, obtuse, when enclosing the bud boat-shaped. Peduncles vary greatly in length, generally from 3 to 9 lines long, but occasionally elongated from 1 to 3 inches, and sometimes thickened in fruit. Spikes about as often interrupted as capitate in all the forms, 3–10-flowered. Fruit obliquely elliptical, ¾–1 line long and ½–¾ line wide, curved and 2-grooved on the back, or sometimes with 3 distinct keels; face slightly arched or often with a projecting curve above and an inward curve below, beaked by a short, straight or recurved style; apex of the embryo slightly incurved and pointing obliquely downwards.

Var. PANORMITANUS (Biv). Morong.
P. Panormitanus, Biv. Sic. Pl. (1806–7).

Uppermost leaves subcoriaceous, spatulate, opposite, divaricate, in 1 or 2 pairs, 3–5-nerved, with cross-veins and often covered with a chain-like areolation, 4–5 lines long, sloping at base into a broad petiole as long as the blade. Collected in pools at Ottawa, Canada, by James Fletcher, July 1882.

Var. POLYPHYLLUS, Morong, Bot. Gaz. v. 51 (1880).

A dwarf form 3–5 inches high, divaricately branching from the base, and very leafy throughout. Leaves very obtuse, 3-nerved. Not flowering, but abundantly provided with propagating buds which are found on the thickened and hardened ends of the branches, and closely invested by imbricated leaves. In a shallow pool, with oozy bottom, some distance under water, South Natick, Mass. (Morong); Fresh Pond, Cambridge, Mass. (Faxon).

Var. ELONGATUS, Ar. Bennett. Macoun's Cat. Can. Pl. Pt. 5, 371 (1890).

I have not seen a specimen of this form, but it is thus described by Mr. Bennett in Jour. Bot. for May, 1891, p. 151: "This differs from *pusillus* by the larger size of all its parts and very long internodes; leaves remarkably elongated; peduncles stout and long; spikes much longer; leaves often quite acute; flowers larger in all their parts. Habit of *rutilus*, Wolfg., and so named in specimens from Hungary in Herb. Mus. Brit." Coll. Macoun, Spallumsheen River, at and above Enderby, B. C.

Var. STURROCKII, Ar. Bennett, in Hook. Stud. Fl. 435 (1884).

This form occurs rather rarely in the United States. It is distinguished by its delicate, bright green, pellucid leaves, which are 1–3 inches long, obtuse or often apiculate at the apex and ½–¾ line broad. Mr. Bennett states that the British specimens are sometimes 5-nerved, but I have seen none with more than 3 nerves. There is often, however, at least in American specimens, a finely-reticulated space on each side of the midrib. The fruit, according to Mr. Bennett, is much smaller than in the type, with a short beak. This I have not seen.

P. pusillus seems to be the central species of a group, being approached on the one hand by *P. lateralis*, and on the other by

gemmiparus and *major*, all together forming a well-marked aggregate.

A widely-diffused species, common in Canada from New Brunswick to British Columbia, New England to Louisiana and Texas, west to Oregon and California. San Luis Potosi, Mexico, Schaffner, No. 533. Europe. Pools and ditches. July, August. (Plate LIII.)

30. POTAMOGETON GEMMIPARUS (Robbins) Morong, Bot. Gaz. v. 51 (1880).

P. pusillus L., var. ? *gemmiparus*, Robbins in A. Gray, Man. Ed. 5, 489 (1867).

Stems filiform, branching, terete, greatly varying in height, rising from 5 inches to 4 feet, according to the depth of water in which it grows; the internodes below, especially in deep water forms, as much as 5 inches in length. Leaves capillary, sometimes not as broad as the stem, often with no perceptible midrib, tapering to the finest point, 1–3 inches long, biglandular at base; stipules ½–1 inch in length, acute or obtuse, mostly deciduous. Rarely flowering, the spikes interrupted, 3–6-flowered; peduncles filiform, sometimes a little thickened, ½–2 inches long. Fruit exceedingly rare, and in size and shape like that of *P. pusillus*, except that it is flatter and somewhat impressed on the sides. It is commonly propagated by gemmae, which are abundant. The leaves and stems are often alike in thickness, so that the plant seems to consist of threads, and this with the long, naked internodes, renders its appearance very peculiar.

A few specimens in fruit were obtained at Amherst, Mass. by Prof. H. G. Jesup in 1874, and by him sent to Dr. Robbins, who thereupon substituted in his herbarium the name here adopted. It was first found by Dr. Robbins in the Blackstone Valley from Worcester, Mass. to Providence, R. I., and has since been collected by myself in the Charles River, at South Natick, Mass. Also by Mr. J. F. Collins, in Central Pond, R. I. Pools and slow moving streams. August, September. (Plate LIV. The rare fruiting form is seen on the right.)

31. POTAMOGETON DIVERSIFOLIUS, Raf. Med. Repos. 2d Hex. v. 354 (1808).

P. hybridus, Mx. Fl. i. 101 (1803).

We are obliged to drop the name of Michaux, because it had been previously employed by Thuillier for *P. heterophyllus* (Fl. Par. 1790), and that of Rafinesque comes next in date.

Stems flattened, sometimes terete, much-branched, but never recurved as sometimes occurs in *P. Spirillus*. Floating leaves coriaceous, the largest 12 lines long by 6 lines wide, oval, elliptical and obtuse or lance-oblong and acute. Petioles generally shorter, but sometimes longer than the blades, filiform or dilated. Submerged leaves setaceous, flat, in the typical form seldom over ¼ line in width, 1–3 inches long, 1-nerved, often with many fine lines and long reticulations on each side of the midrib. Stipules obtuse or truncate, hyaline, 3–5 lines in length, on the floating leaves free, on the submerged leaves commonly adnate to the petiole, but often free. Emersed peduncles 3–7 lines long and thickened upwards. Submerged peduncles 2–3 lines long, as long as the spikes, clavate, often recurved. Emersed spikes 3–5 lines long, occasionally interrupted. Fruit rarely over ½ line long and nearly as broad, 3-keeled, middle keel narrowly winged, usually with 7 or 8 knob-like teeth on the margin, the lateral keels sharp or sometimes rounded; style quite apparent as a short point, apical; embryo coiled 1½ times. This and the following species are much alike in general appearance and often confounded. In well-marked forms, however, the two may readily be distinguished not only by the difference in the submerged peduncles, but by the width of the submerged leaves, those of *P. diversifolius* being capillary or setaceous and only 1-nerved. Sometimes the leaves are broader, and then the chief mark of distinction lies in the submerged peduncles. Both species are really intermediate between the section of Potamogetons with free stipules and that with adnate stipules, as in the uppermost leaves the stipules are free, and adnate only in the lower. In extent of adnation this species approaches the former and the following species the latter.

Var. MULTI-DENTICULATUS, Morong, n. var.

Varies from the type in the numerous teeth on the fruit, as many as 12 being sometimes found on the middle keel, and each

lateral keel with 6 or 8 more. Frequently the teeth are bristle-like, and sometimes 2-pronged. The submerged leaves are from ¼ to ½ line in width, rarely as narrow as in the type. The most distinctly-marked specimens of this form were collected by Mr. C. F. Parker in a pond at Rehoboth City, Delaware, August 7, 1878. I have since noted the following localities for it: Noank, Conn. (Morong); ponds on the Susquehanna and at Easton, Pa. (Porter); Florida (Curtiss, Regel, No. 72); Lower Louisiana (Langlois).

Var. TRICHOPHYLLUS, Morong, n. var.

About 6 inches in height, without floating leaves, the submerged leaves as fine as floss silk, and entirely destitute of nerves.

Coll. N. L. Britton, Lake Marcia, Sussex Co. New Jersey.

The species in pools and ponds from New England to Nebraska, and south to Florida and Texas, San Luis Potosi, Mexico (Schaffner No. 534 and Parry and Palmer No. 856). Cuba (Wright). It ranges farther to the south than *Spirillus* and not so far north. It occurs in Maine, but Prof. Macoun expresses a doubt whether the Canadian forms attributed to this species are not *Spirillus* and such as I have seen from Canada confirm his opinion. (Plate LV.)

32. POTAMOGETON SPIRILLUS, Tuckerm. Am. Jour. Sci. and Arts, 2d series. vi. 228 (1848).

P. Zetterstedtii, Wallm. ap. Sch. et Mohl. Bot. Zeit. i. 256 (1843)? (fide Bennett Jour. Bot. xxviii. 298.)

Stems compressed, much branched, the branches often short and recurved, 6–20 inches high. Floating leaves coriaceous, obtuse, usually opposite and in several pairs towards the summit of the stem, oval or elliptical, varying to lanceolate, the largest about 12 lines long by 6 lines wide, sometimes narrow-oblong, deeply impressed beneath by 5–13-nerves. Petiole commonly about equal to the blade, but sometimes only ¼ or ½ its length, somewhat dilated. Submerged leaves linear, obtuse or abruptly acute, 1½–2 lines long and ¼–½ line wide, uppermost sometimes 1 line wide, usually 3-nerved, the lateral nerves near the margin, rarely with 5 very delicate nerves, often with irregular reticulated spaces on each side of the midrib. Stipules, like those of the preceding species, on the uppermost floating leaves entirely free, on the lower adnate to the petiole near the base, on the submerged adnate to

the leaf for about one-half their length. In dried specimens, the stipules appear free from all the floating leaves. Emersed peduncles usually similar to those of the preceding species. Submerged peduncles usually wanting, or at most, hardly 1 line long. Spikes above water 3–5 lines long, continuous, while the lower are mostly sessile in the axis of branches, capitate and ripening from 1 to 4 fruit. Fruit cochleate, very thin, nearly fleshless, roundish, about ¾ line long and nearly as broad, flat and deeply impressed on the sides, 3-keeled on the back, middle keel winged, wing broad and with 4 or 5 large teeth or very narrow and without teeth, the lateral keels rounded; style usually marked on the dried fruit only by a slight projection or a scar; embryo commonly coiled about 1¾ turns. The spiral markings of the embryo are distinctly seen in the dried fruit, and are a very distinctive feature, strongly reminding one of a small snail shell.

Pools, ditches and ponds. Nova Scotia (Mrs. E. G. Britton); New Brunswick, Quebec and Ontario (Macoun). Common in New England, and west to Minnesota, Missouri (Blankenship) and Nebraska, south to Pennsylvania and Virginia. (Plate LVI.)

33. Potamogeton filiformis, Pers. Syn. i. 152 (1805).

P. marinus of authors, not L. Herb.

Stems from a running rootstock, slender, 3–20 feet in height, filiform above, stout and thick towards the base. Flowers on long, often drooping peduncles, the longest measuring 6 to 8 inches, 2–4 in a whorl and the whorls ¼–1 inch apart. Leaves numerous, 2–10 inches long and from ⅛ to ¼ line, very rarely ½ line, broad, 1-nerved, with a few cross nerves. Sheaths about 1 line long, and the free part of the stipule ½ inch more, scarious on the edges. From 3 to 12 drupes are ripened in a verticil. Fruit 1–1½ lines long and about ¾ line wide; sides even; back not keeled in fresh specimens and scarcely so in the dry; face nearly straight or obtusely angled near the top; stigma nearly or quite sessile, remaining on the dry fruit as a broad truncate projection, apical or subapical; embryo circle incomplete, the apex pointing slightly inside of the basal end.

Var. Macounii, Morong, Macoun's Cat. Can. Pl. pt. 4. 88 (1888.)

Quite a distinct form with leaves 1–3 inches long, the largest ½ a line or a little more in width, obtuse, stiff, with a strong mid-

rib and raised or slightly revolute margins. Fruit small, rarely more than a line in length and ¾ of a line in breadth. Peduncles short, not more than 8 or 10 lines long at the most. This form commonly has a compact, bushy habit which is quite noticeable. Occurs in brackish and salt lakes of the prairie region, in Old Wives' Lakes and Crawling Valley, south of the Hand Hills, Alberta, Canada (Macoun). This approaches:

Var. *occidentalis*, Robbins, Bot. King's Ex. 339 (1871).

This as described by Robbins has some of the leaves similar to those of the preceding variety, but the peduncles often as much as 6 inches long, the fruit roundish-obovate, and the sides of the nutlet made "uneven by a central elevation partially surrounded by a shallow depression which is marginned by the raised lateral keel." Ruby Lake, Nevada, 6,000 feet alt., (Watson); Shoshone Geyer Basin, Wyoming (Clifford Richardson).

The species is rare in the United States, and was first detected by myself in the rapids above Niagara Falls in 1875, and since in similar rapids at Sault Ste. Marie, Mich. It is abundant in Seneca Lake, N. Y., and Mr. Hill has obtained it in Hemlock Lake, Western New York and Frankfort, Mich. It is more common in Canada, having been obtained by Prof. Macoun in brackish marshes on the sea coast at the Island of Anticosti, and in fresh water lakes and creeks in the Northeast territory, Manitoba and British Columbia. August. (Plate LVII.)

34. Potamogeton pectinatus, L. Sp. Pl. 127 (1753).

Stems slender, from a running rootstock, much branched, the branches repeatedly forking, 1 to 3 feet in height, usually much stouter below. Leaves setaceous, attenuate to the apex, 1-nerved, 1–6 inches long, often capillary and without nerves. Gigantic forms were collected by Prof. W. R. Dudley in Lake Cayuga, from 18 to 20 feet in length, and with leaves even 10 inches long. The form *scoparius*, Wallr., found in this country as well as in England, has numerous hair-like fasciculated leaves, very long and broom-like in appearance, whence the name. Stipules with sheaths which are white and scarious on the edges, ½–1 inch long, and half as much free. Peduncles filiform, 2 to 12 inches long, the flowers in approximate or distant verticils, 2 to 4 flowers

ripening 2 to 8 seeds, in a verticil. Fruit roundish obovate or obliquely obovate, with a thick hard shell, 1½–2 lines long and 1–1¼ lines wide, without a middle keel, but with obscure lateral ridges on the back, plump on the sides, and curved, occasionally a little angled on the face; style distinct, straight or recurved, facial; embryo apex nearly touching and pointing directly towards the basal end. In American plants, the keels are generally obscure and often obsolete, and the fruit more nearly approaches that of *filiformis* in size.

This species is frequently propagated by root tubercles which are nearly as large as peas and lie imbedded in the mud through the winter. In this state they are eaten by wild fowl, and the crops of these birds are often filled with them.

P. pectinatus and *P. filiformis* are often confounded, and in the absence of fruit it is impossible in all cases to make sure of the species. As a general rule *P. filiformis* is a smaller plant. In regard to the fruit, that of *P. pectinatus* may always be known from *filiformis* by its distinct and often recurved style, and usually it is larger. Both species occur in brackish water, sometimes in tidal and salt water, and also very extensively in fresh water.

Ponds and rivers. Widely distributed in Canada from Cape Breton to British Columbia and northwards (Macoun). In the United States it ranges from New England to Florida and Texas, and across the continent to Oregon and California. Lower California (Orcutt, Palmer). Southern Mexico (Helmsley). Cuba (Wright). A world-wide species, occurring in Europe, Australia, Africa and Asia. (Plate LVIII.)

35. Potamogeton latifolius (Robbins) Morong.

P. pectinatus, var. (?) *latifolius*, Robbins, Bot. King's Ex. 338 (1871).

Stem stout, white, branching, 2–3 feet high. Leaves numerous, flat, 1–3 inches long and 1–2 lines broad, 3–5 nerved, reticulate with many cross veins, obtuse or abruptly apiculate, the narrower ones acute. The part of the stipule adnate to the leaf, broad, many-nerved, scarious-margined, ½–1 inch long, the free portion shorter. Peduncles 1–3 inches long. Spikes interrupted. Mature fruit much like those of *pectinatus*, while the foliage differs greatly.

Fruit about 2 lines long by 1½ lines wide; back usually without a keel, the lateral ridges rounded; face gibbous at the top; style facial, rather long, erect or slightly recurved; embryo apex pointing slightly inside of the basal end. Often in the fruit the curve of the back rises at the top almost as high as the style, making that appear as if on the face, a peculiarity which occurs sometimes in *pectinatus* also. It is a question whether this form is the same as the broad-leaved forms of *flabellatus*, but it differs from that species not only in fruit characters, but in having many short lateral branches, shorter and more obtuse leaves, and a stouter and stricter stem.

The plant described by Robbins was collected in the "running brackish waters of Humboldt River below Humboldt Lake," Nevada. A fine specimen is in the Herb. of Mr. I. C. Martindale, of Camden, New Jersey, collected by Mrs. R. M. Austin in Goose Lake, Northeastern California, in Sept. 1884. The fruit here described is taken from that specimen. (Plate LIX.)

36. Potamogeton interruptus, Kitaibel; Schultes, Œst. Fl. Ed. 2, 328 (1814), fide Ar. Bennett.
P. flabellatus, Babington, Man. Bot. Ed. 3, 343 (1851).

From a running rootstock which often springs from a small tuber. Stems stout, branching, 2–3 feet in height, the branches spreading like a fan. Leaves linear, obtuse or acute, 3–5 inches long, 1 line or a little more in width, 3–5-nerved, with many transverse veins.* Narrow, 1-nerved leaves occur on some plants, and these are acuminate, much like those of *P. pectinatus*. Stipule on the adnate part ½–1 inch long, without scarious edges, or narrowly scarious, the free part shorter and scarious, obtuse. Peduncles 1–2 inches long. Spikes slightly interrupted.

Our United States plants have never been observed in fruit, but I am able to give the fruit characters from specimens kindly

* It should be noted that Mr. Fryer regards these broad leaves as belonging mostly to sterile or autumnal shoots. Normally, as he describes the leaves, they are narrow or setaceous like those of *pectinatus*. The chief difference between the species and *pectinatus*, in his opinion, lies in the fruit. But as these broad leaves are the only ones so far found in the United States, and as they are the kind originally attributed to the species by Prof. Babington, I can only pay regard to them in this account of our species.

furnished by Mr. Fryer and collected by him in Cambridgeshire, England, where the plant is common. Fruit broadly obliquely obovate, obtuse at base, the largest 2 lines long by 1¾ lines wide, prominently keeled and with rounded lateral ridges on the back; face nearly or quite straight, sometimes gibbous at the top; style facial, erect; embryo outline obovate, the apex pointing slightly inside of the basal end. The shell of the drupe is exceedingly thick and quite hard.

First found by Mr. E. J. Hill in ponds at Manistee, Mich., and subsequently collected by myself in the same locality. Also collected by Mr. Hill in the Channel Islands, St. Mary's River, Mich. Mr. Hill takes especial notice of the tubers by which this species is frequently propagated. This method of propagation it has in common with *P. pectinatus*, to which it is closely allied. (Plate LX.)

37. Potamogeton Robbinsii, Oakes, Hovey's Mag. May, 1841, p. 2.

Stems stout, widely branching, 2–4 feet high, from running rootstocks sometimes 10 or 12 inches long. Leaves 3–5 inches long, 2–3 lines wide, acute, finely many-nerved, crowded in 2 ranks, minutely serrulate under the lens, auriculate at the point of attachment with the stipule. Stipules with the adnate portion and sheathing base of the leaf about ½ an inch long, the free part from ½ to 1 inch, acute, persistent, white, membranous, mostly lacerate. Peduncles 1–3 inches long, the infloresence frequently much branched and bearing from 5 to 20 peduncles. Spikes interrupted, ½–¾ inch long, flowering under water, but the rarest of all our North American species to form fruit. It is propagated very extensively by fragments of the stems, which throw out many rootlets from every joint. I have seen such rootlets from 6 to 10 inches long on floating specimens, and even a stem standing upside down in the mud and growing apparently as well as in the normal position. Very rarely in years when the waters are low, the flowering spikes rise above the surface and perfect a few fruit. Dr. Robbins never saw but one fruit, which was collected many years ago in Oregon by Hall, and this was split in two, Prof. D. C. Eaton taking one-half and Dr. Robbins the other. In the year

1880 Mr. E. Faxon had the good fortune to secure a few fruiting specimens in Jamaica Pond, Mass. Besides them I have never known another instance, although the plant is very prolific in the localities where it occurs, sometimes densely covering the bottoms of ponds for acres. Mature fruit obovate, about 2 lines long by 1½ lines wide, 3-keeled on the back, the middle keel sharp and prominent, the laterals rounded; face arched; sides with a shallow depression which runs into the face below the arch; style subapical, thick, slightly recurved, obliquely truncate; apex of the embryo pointing slightly inside of the basal end.

So far as known, confined to the northern part of North America. New Brunswick, Ontario, Lake Superior (Macoun); New England to Northern New Jersey, and westward to Oregon (Hall, Wilkes' Exploring Expedition). (Plate LXI.)

5. RUPPIA, L. Sp. Pl. 127 (1753).

Stems capillary, widely branched. Leaves very slender, alternate, 1-nerved, tapering to an acuminate point, with a membranous sheath at the base. Flowers on a capillary, spadix-like peduncle, naked, perfect, consisting of two sessile anthers, each with 2 large, separate cells, attached by the back to the peduncle, having between them several pistillate flowers, in 2 sets, on opposite sides of the rachis, the whole at first enclosed in the sheathing base of the leaf; stigmas sessile, peltate. In the development, the staminate flowers drop off, and the peduncle elongates, bearing the pistillate flowers in two clusters at the end. The flowers are fertilized above water, after which the peduncles coil up and are drawn beneath the surface. Fruit a small, obliquely pointed drupe, several in each cluster, pedicelled; embryo oval, the cotyledonary end inflexed, and both that and the radicle immersed.

Half a dozen or more species have been enumerated, but probably all may be reduced to two or three. In salt, brackish and fresh waters throughout the world.

1. Ruppia maritima, L. Sp. Pl. 127 (1753).

Stems often whitish, 2 or 3 feet high, the nodes irregular, naked, 1–3 inches long. Leaves 1–3 inches in length and ¼ line or less in breadth; sheaths membranous, 3–4 lines long and with a minute ligule or short free tip at the top. In fruit the peduncles

are greatly elongated, sometimes as much as 12 inches or even more; pedicels 4–6 in a cluster, ½–1½ inches in length. Drupes with a dark hard shell, about 1 line long, ovoid, often oblique or gibbous at base, pointed with the long style. The drupes vary a good deal in shape, usually simply conical with a short gibbous swelling at the base, sometimes with a strong spur-like projection and a curved outline, as in the form known in Europe as *R. rostellata*, Koch, which does not, however, differ otherwise from the type. Specimens with fruit of this shape are sent from Oregon by Mr. Howell. Forms with fruit nearly destitute of peduncles and pedicels, and broad strongly marked sheaths, similar in these respects to *R. brachypus*, Gay, occur at Wood's Holl, Mass., and at other places along the Atlantic coast. (Plate LXII.)

2. Ruppia occidentalis, S. Watson, Proc. Am. Acad. Sept. 25, 1890, p. 138.

R. lacustris, Macoun, Cat. Can. Pl. Pt. 5. 372, Nov. 1890.

A stoutish-stemmed plant 1–2 feet high, the branches forking in fan shape. Leaves 3–8 inches long, with large sheaths ½–1½ inches in length. Branches and leaves often thickly clustered at the nodes, the sheaths overlapping each other. Drupes large, 1½–2 lines long, of a thick pear shape, on pedicels ¾–1 inch long. Prof. Macoun states that the peduncles are bright red when fresh.

Coll. by Macoun in a saline pond at Kamloops, B. Columbia. Also collected by H. J. Webber in a saline region at Alliance, Box Butte Co., Nebraska. Mr. Webber writes that he found peduncles nearly 2 feet in length. (Plate LXIII.)

6. ZANNICHELLIA, L. Sp. Pl. 969 (1753).

Stems, flowers and leaf buds all at first enclosed in a hyaline envelope, a sort of spathe, corresponding to the stipule of *Potamogoton*, rising from a node. Staminate and pistillate flowers in the same axil; the stamen solitary, 2-celled, on a short pedicel-like filament; pistillate 2–5 or more in a special envelope of their own. The stamen is said to be 4-celled occasionally, but I never could find more than 2 cells. Ovary a flask-shaped body, stipulate at base, tapering into a short style, with a broad, hyaline stigma which is somewhat cup-shaped, and has irregular, angled or dentate edges. Sometimes the whole cluster of flowers is on a stipe

or peduncle. In fruit the stipe and style lengthen, and the ovary is prolonged iuto a flattish, falcate nutlet, ribbed or sometimes toothed on the back. Seeds corresponding to fruit; the embryo bent and coiled at the cotyledonary end.

Found in all parts of the world. Half a dozen different species have been described by authors, but most of them can be reduced to the following species, and probably not more than 2 or 3 species exist.

1. Zannichellia palustris L, Sp. Pl. 969 (1753).

Flowering and ripening its fruit under water. Stems capillary, sparsely branched, from a creeping rhizome and fibrous roots, 1–2 feet high. Leaves 1–3 inches long, ¼ line or less in breadth, acute, thin, 1-nerved and with a few delicate cross nerves. Spathe or stipule separating from the leaves and fruit at maturity, persistent. Fruit 2–4, sometimes 6, in a cluster, falcate, 1–2 lines long, variously disposed, sometimes sessile, sometimes, as in forma *pedicellata*, J. Gay, each on a pedicel, or, as in forma *pedunculata* A. Gray, the whole cluster on a short peduncle. The fruit is generally ribbed or winged on both margins, but sometimes without an apparent rib and sometimes dorsally knobbed or toothed; style persistent, recurved, ½–1 line long. In var. *muricata*, Morong, which occurs in Texas and California, the fruit has distinct teeth on the back and is bristly-muricate on the sides. All these forms may sometimes be found on a single plant, or, at least, in the same cluster, and can hardly be regarded as varieties.

Fresh and brackish ponds and pools, sometimes in tidewater. Common throughout Canada and the United States, as well as in all other parts of the world. (Plate LXIV.)

7. NAIAS, L. Sp. Pl. 1015 (1753).

Slender, branching plants with fibrous roots, wholly submerged. Leaves opposite, alternate or verticillate in 3's or more, sheathing at the base, nerveless. Flowers monœcious or diœcious, axillary, solitary, sessile or pedicellate. Sterile flower with a double perianth, the exterior one entire or 4-horned at the apex, the internal hyaline, adhering to the anther; stamen sessile or stipitate, 1–4-celled, apiculate or 2-lobed at the apex, rupturing irregularly. Fertile flower of a single ovary which tapers into a short style

that is split somewhat irregularly into 2–4 subulate stigmas. The mature carpel is solitary, sessile, ellipsoidal, with a crustaceous pericarp; seed conformed to the pericarp, and the embryo to the seed, the plumule and radicle immersed. Generally the raphe is distinctly marked on the seed.

About 10 species are known, inhabitants of fresh water in tropical and temperate regions. Four species occur in North America, three of them belonging to the section *Caulinia*, as constituted by Willdenow, that is, species with the stems and backs of the leaves unarmed.

1. Naias marina, L. Sp. Pl. 1015 (1753).
N. major, All. Fl. Ped. ii. 221 (1785).

A dicœcious plant with rather stout compressed stems commonly armed with teeth half as long as their breadth. Leaves opposite or in 3's, 6–18 lines long, about 1 line broad, with 6–10 spine-pointed teeth on each margin, and frequently several along the back. Sheaths with rounded lateral edges, the type form without teeth. The teeth vary much in size and number. Sometimes the stem is entirely naked, sometimes with only one or two teeth. The teeth on the leaf margins have a large basal prominence which often imparts a zig-zag appearance to the outline, this prominence being composed of several cells which buttress the yellow, 1-celled spine at the tip. Fruit large (2–2½ lines long), the pericarp, as well as the seed, rugosely reticulate, tipped with a long, persistent style and 3 thread-like stigmas; seed not shining. A polymorphous species, the extreme forms of which would hardly be recognized as belonging together. A. Braun enumerates 6 forms, of which his variety *Ehrenbergii*, with unarmed stem, the edges of the sheath furnished with 1–2 teeth, occurs in Florida (Dr. E. Palmer); and his variety *intermedia*, or very nearly that, with long, naked internodes, leaves narrow, linear, each margin with 5 or 6 large teeth, which are usually longer than the breadth of the leaf, without dorsal teeth, the sheath on each side with 1–4 teeth, and fruit nearly 3 lines long, occurs in Lake Cayuga, New York (Morong).

Besides these the two following well-marked forms occur in the United States:

Var. GRACILIS, Morong, Bot. Gaz. 10, 255 (1885).

Internodes 1–3 inches in length, with a few teeth near the upper part. Leaves scarcely ¼ line wide, with 15 to 24 large teeth on the margins and few dorsal teeth; sheaths with 2–3 teeth on each margin; seeds hardly 2 lines long and sculptured with about 25 rows of nearly square or irregularly oblong reticulations. The whole plant, at least when dry, purple tinged.

Florida (A. H. Curtiss, No. 2705). A form very nearly, if not quite this, was collected by Prof. Wm. R. Dudley off Canoga marshes, New York (Cayuga Flora, p. 104).

Var. RECURVATA, Dudley, Cay. Fl. 104 (1886).

Stems dichotomously branched, the branches and leaves recurved. Leaves 3–6 lines long, narrow, with 2–4 large teeth on each margin longer than their breadth, without dorsal teeth; internodes short, naked, or with 1 or 2 teeth; sheaths 1-toothed on each side.

Black Lake, Cayuga Marshes, New York (Dudley).

The species rare in North America. Canoga Marshes and Cayuga Lake, N. Y. (Morong, Dudley); Florida (Chap. Fl.); Utah (Parry); Lower California (Palmer.) Attributed by Watson in Bot. Cal. to Clear Lake (Bolander) and Huntington Valley, Nevada (Wheeler). Cuba. Occurs in Europe and Asia. (Plate LXV.)

2. NAIAS FLEXILIS (Willd.) Rostk. and Schmidt. Fl. Sed. 384 (1824).

Caulinia flexilis, Willd, in Act. Ac. Berol. 89 (1798).
Naias Canadensis, Mx. Fl. ii. 220 (1803).

Stems slender, dichotomously much branched. Leaves linear, pellucid, acuminate or abruptly acute, ½–1 inch long by ½–1 line wide, numerous and crowded on the upper part of the branches, with 25–30 minute 1-celled teeth on each edge; sheaths obliquely rounded, with 5–10 teeth on each edge. Dicœcious. Fruit ellipsoidal, with very thin pericarp, 1–1¾ lines long and ¼–½ of a line in diameter; style long, divided into 3 short stigmas, persistent; seeds smooth, shining, sculptured, sometimes quite faintly, with 30–40 rows of squarish or hexagonal reticulations which are scarcely seen through the pericarp. The seeds are generally

straw colored, but sometimes quite dark; pericarp dull and dark. This species occurs in various forms, some of them very small and bushy, 2 or 3 inches high, others a foot or more high, and nearly capillary, the foliage generally a dusky purple, but sometimes a bright green.

Var. ROBUSTA, Morong, Bot. Gaz. x. 255 (1885).

Stem stout, comparatively few leaved, internodes long, sparsely branched, 3–6 feet high.

Ponds and rivers in Eastern Massachusetts, New York, Michigan and Texas.

The typical plant is widely diffused in North America, being found in Canada, from the Atlantic to the Pacific, and equally common in the United States and Mexico. It is as widely distributed in the Old World. (Plate LXVI.)

3. NAIAS GUADALUPENSIS (Spreng.) Morong.

Caulinia Guadalupensis, Spreng. Syst. 1. 20 (1826).

N. flexilis, var. (?) *fusiformis*, Chap. Fl. 444 (1860).

N. flexilis, var. *Guadalupensis*, A. Br. Seeman's Jour. Bot. ii. 274 (1864).

N. microdon, var. *Guadalupensis*, A. Br. Rep. Nat. His. Soc. Berl. June 16, 1868.

N. microdon, Morong, Bot. Gaz. x. 255 (1885).

Stems almost capillary, 1–2 feet high, numerously and widely branched from the base. Leaves numerous, ½–¾ of an inch long, ¼–½ of a line broad, acute, opposite or 3–5 fascicled, frequently recurved, with sheaths and teeth like those of *N. flexilis*, but generally with 40–50 teeth on each edge of the leaf. Fruit about 1 line long; pericarp dark and strongly marked by 16–20 rows of hexagonal or rectangular reticulations which are transversely oblong; seed straw-colored, not shining.

This species is easily confounded with *N. flexilis*, but is clearly distinct in its long narrowly outlined branches, its short leaves, and especially in the markings of the fruit and seed.

Florida (A. H. Curtiss, Chapman); Louisiana (Langlois); Texas (Lindheimer, Reverchon); Nebraska (T. A. Williams); Oregon (Howell). West India Islands (Duchassaing, Wright). Mexico (Müller). (Plate LXVII.)

4. Naias gracillima (A. Br.) Morong.

N. Indica, Willd. var. *gracillima*, A. Br. by Engelmann in A. Gray, Man. Ed. 5, 681 (1868).

Stems almost capillary, 6–15 inches high, much branched, the branches alternate; the whole aspect of the plant very graceful. Leaves numerous, opposite or often fascicled, 3–5 or more in the bundle, setaceous, ½–2 inches long, usually with about 20 minute teeth on each margin. The marginal teeth are erect, with 1-celled yellowish spiny tips as in the other species, buttressed by 2, sometimes 3 cells on the basal protuberance which give them the aspect of being 3 or more celled. Sheaths auricled, with 6 or 7 teeth on each auricle, the teeth standing upon setaceous divisions of the sheath. Diœcious. Styles bifid, the 2 stigmas very short. Fruit oblong cylindrical, about ½ line long by ¼ line in diameter, slightly curved inwardly, the pericarp straw-colored or often purplish, marked by about 25 rows of irregularly oblong reticulations; seed not shining.

This plant differs very decidedly from *N. Indica*, of which Braun made it a variety. It has more slender and longer leaves, smaller and fewer teeth, and different fruit from that of *N. Indica*, which is described as ovate. It has sometimes been called *N. minor*, a very different species, which is not known to occur in this country.

In pools and ponds, still water, Ashland, Worcester, Winchester and Stoneham, Mass. (Boott, Morong); Albany, New York (Peck); Woodstown, New Jersey (Commons). Tidal mud of the Delaware, Camden, New Jersey, and Bristol, Pa. (Porter); Missouri (Engelmann.) (Plate LXVIII.)

8. ZOSTERA, L. Sp. Pl. 968 (1753).

Marine plants with slender rhizomes which root at the joints. Stems branching, compressed. Leaves distichous, sheathing at the base, the sheaths stipuliform, with inflexed margins. Spadix linear, contained in a spathe which is merely a sheath with overlapping flaps in the lower part of a leaf, or, as some botanists prefer to say, the spathe is on a long peduncle and has a long foliaceous appendage at the top. Upon the spadix the two kinds of flowers are arranged alternately in two rows. Sterile flower merely an anther attached to the spadix near its apex, 1-celled, opening

irregularly on the ventral side; pollen threadlike. Fertile flower fixed on the back near the middle; ovary attenuate into a style as long as itself; stigmas 2, capillary. Mature carpels flask-shaped, membranaceous, rupturing irregularly, beaked by the persistent style. Seeds ribbed, the ribs showing through the dried pericarp, enclosed in a firm membranaceous test; embryo thick, ellipsoidal, the cotyledonary end contained in a longitudinal furrow.

Species 5 or 6, natives of temperate seas throughout the world. Of these 3 are found on the North American coast.

1. Zostera marina, L. Sp. Pl. 968 (1753).

Leaves ribbon-like, obtuse at the apex, 1–5 feet or more long and 1–4 lines wide, having 3–7 principal nerves and many fine ones between them, the nerves often obscure. The sterile plants are generally larger and more vigorous than the fertile. Spadix ¾–2½ inches long; flowers about 3 lines in length, crowded, varying greatly in the proportionate number of each kind, and from 10 to 20 of each. Sometimes the anthers are arranged obliquely in 2's and 3's. Ovaries somewhat vermiform. At anthesis the stigmas are thrust through the opening of the spathe and drop off before the anthers on the same spadix open, showing that they are fertilized by pollen from other plants. The anthers at the time of anthesis work themselves out of the spathe and discharge the sticky, stringy pollen in the water, thus leaving the ovaries by themselves, which then appear regularly disposed in two rows. Seeds cylindrical, strongly 20-ribbed, about 1½ lines long and ½ line in diameter, truncate at both ends. The ribs show very clearly on the pericarp.

The plant described under the name *Z. Oregana*, by Dr. S. Watson in Proc. Am. Ac. 26. 131 (1891), was founded upon a single specimen in the Gray Herb., collected by Hall in Oregon in 1871. A careful examination of this shows that it is only our common *Z. marina*. The only substantial points on which Mr. Watson relies to establish the species are the long straight beak of the fruit and the lack of a foliar appendage on the spathe. The beak is characteristic of all *Zostera* fruit, and the single spathe on Hall's specimen has the appendage broken off, as the jagged edges seen under a lens distinctly show. I have seen scores of them in

dried specimens broken off in the same way. In every other respect the plant is *Z. marina*.

This species is common in sheltered bays and marsh ditches between high and low water mark along the Atlantic coast from Greenland to Florida, and on the Pacific coast from Alaska to California. Europe and Asia. (Plate LXIX.)

2. Zostera minor (Cavol.) Nolte, in Reich. Ic. vii. 2 (1845).
Phucagrostis minor, Cavol. Phuc. Th. Anth. xiv. (1792).
Z. nana, Roth, Enum. Pl. Germ. p. 8 (1827).

A specimen which probably belongs to this species, collected at Key West, Florida, by Blodgett is in the Torrey Herb. Leaves 3–6 inches long, scarcely ¾ of a line wide, 1-nerved. It lacks fruit, however, to make its rank sure. The seeds of this species in English specimens are about ¾ of a line long, and smooth or very faintly striate, only 4 or 5 maturing in the spathe. (Plate LXX.)

3. Zostera latifolia, Morong.
Z. marina, L. var. (?) *latifolia*, Morong, Bull. Torr. Club, xiii, 160 (1886).
Z. Pacifica, S. Watson, Proc. Am. Ac. 26, 131 (1891).

Rootstocks very thick, sending up a stout stem which is sometimes 8 or 10 feet in length. Leaves 2–4 feet long, 3–6 lines wide, the broadest having from 10 to 13 nerves and 7 or 8 striæ between each pair of nerves. Spadices 2–3 inches in length. Fruit 1½–2 lines long by about 1 line in diameter, cylindrical, with a straight beak as long as itself and attached to the spadix by a short stipe, distinctly 20–25 costate. Pericarp membranaceous, splitting regularly along the face, the ribs of the seed marked upon the pericarp in the dried specimens.

Puget Sound (Nevins); Santa Barbara, Cal. (Mrs. R. F. Bingham); Bolinas Bay (Prof. E. L. Greene). Monterey (Dr. C. L. Anderson). (Plate LXXI.)

9. PHYLLOSPADIX, Hook. Fl. Bor. Am. ii. 171 (between 1834 and 1840).

Submerged marine plants with thickened rootstocks, sending up slender stems which bear the inflorescence at the summit or in clusters along the upper part. Leaves linear, grass-like, sub-

coriaceous, sheathing. Flowers diœcious, in spathes like those of *Zostera*. Spathes with membranous edges, the back thickened and terminating in long, leaf-like appendages. Spadix with a series of short, dilated, foliaceous flaps, which close over the flowers, spreading open at maturity. Sterile flowers of numerous sessile stamens, in two rows lying obliquely crowded against each other, 1-celled, dehiscing by a ventral slit, dorsally attached near one side about half-way up; pollen thread-like. Fertile flowers of sessile ovaries, attached above the base, attenuate into a short style; stigmas 2, capillary; ovules pendulous, orthotropous. Fruit coriaceous, indehiscent, beaked by the short persistent style, cordate-sagittate, projecting at base into 2 recurved wings or lobes, and attached to the spadix between them. Seeds globose, with a thick, membranous test; embryo thick, the radicular end flattened ovoid, the cotyledonary end cylindraceous and curved upon the radicle.

Two species only are known, occurring upon the Pacific coast; also on the Asiatic coast.

1. Phyllospadix Torreyi, S. Watson, Proc. Am. Ac. xiv. 303 (1879).

Rootstock usually covered with the fibrillose remains of old leaves. Stems slender, flat, 20 or more inches in height, bearing the spathes in clusters along the upper part. Leaves 3–6 feet in length, ½–¾ line wide, thick, opaque, smooth, obscurely 1–3 nerved, blackening in drying; sheaths very long with narrow, whitish, membranous edges. Spathes 2 or 3 in a cluster, 1–2 inches long, slightly curved, with broad, whitish membranous edges, each spathe on a peduncle ½–1 inch in length. Appendages of the fruiting spadix elliptical, those of the sterile oblong-ovate, both obtuse. Stamens cylindraceous, obtuse at both ends. Ovaries flask-shaped, in fruit laterally flattened and carinate on the back, about 3 lines long. Stigmas long, thrust out of the spathe at anthesis. Test reddish, somewhat shining.

Growing on rocks which are uncovered at low tide.

Santa Barbara, Cal. (Mrs. R. F. Bingham); Los Angeles (Parish Brothers); Bolinas Bay (Prof. E. L. Greene). July-August. (Plate LXXII and LXXIV.)

2. PHYLLOSPADIX SCOULERI, Hook. Fl. Bor. Am. ii. 171, t. 186 (before 1840).

Stems very short, an inch or two in height, bearing solitary spathes. Leaves 3–6 feet long, 1–2 lines wide, 3 nerved, with many fine striae between the nerves. Spadix appendages on both kinds of flowers elliptical, ½ inch long. Fruit broadly flattened, the lobes half as long as the body. In general appearance and inflorescense this is similar to the preceding species, but may be distinguished by its broader leaves, and especially by its short stems and single spathes.

Barclay Sound, Vancouver's Island (Macoun); Tilamook Head, Oregon (Henderson); Dundas Island, Columbia River, Oregon (Scouler). Russian River, Siberia (Ruprecht). (Plates LXXIII and LXXIV.)

Since the sheets of this monograph went to press, I have received specimens of *Potamogeton foliosus* var. *Niagarensis*, collected by Mr. C. F. Wheeler in Cedar River, on the grounds of the Agricultural College in Michigan.

Also *P. rutilus*, Wolfg., collected by the same gentleman in the Detroit River, July 19, 1892.

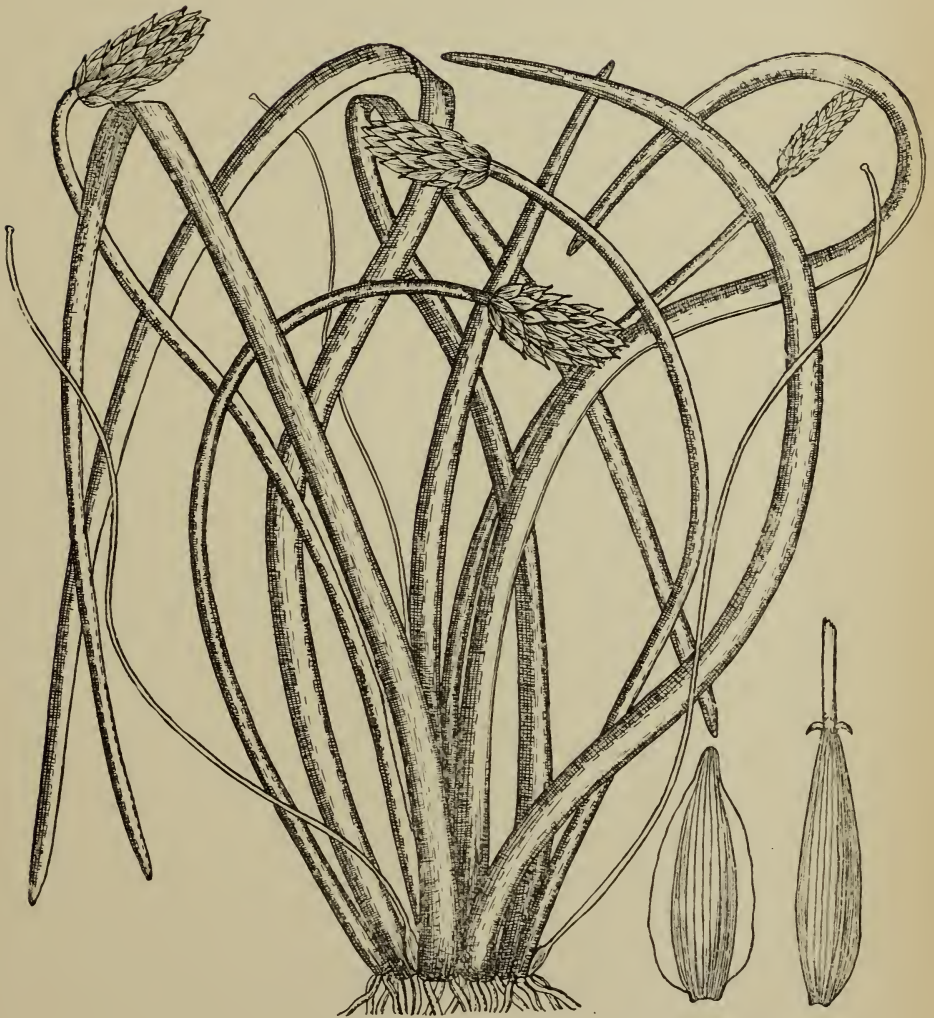
Of the following plates a part were prepared by the author for another work, and are here used by permission.

TRIGLOCHIN PALUSTRIS, L.

TRIGLOCHIN STRIATA, R. & P.

TRIGLOCHIN MARITIMA, L.

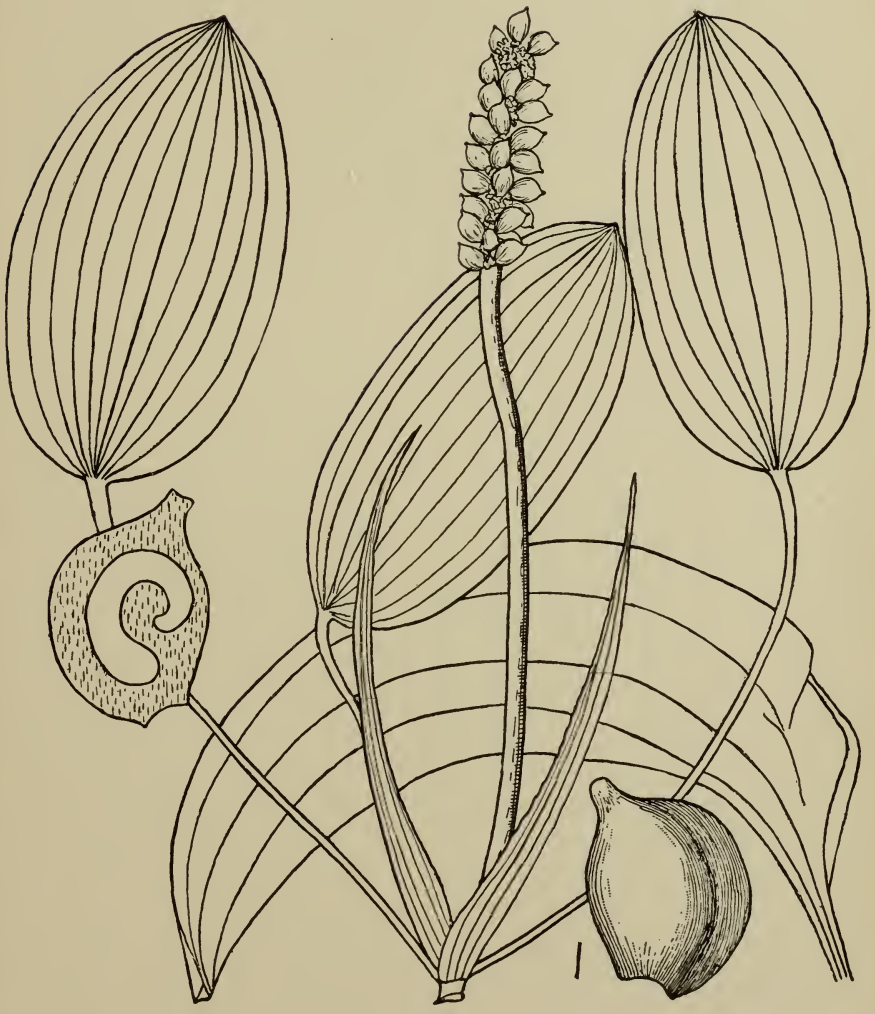
SCHEUCHZERIA PALUSTRIS, L.



LILÆA SUBULATA, H. & B.

POTAMOGETON NATANS. L.

POTAMOGETON OAKESIANUS, ROBBINS.



POTAMOGETON AMPLIFOLIUS, TUCKERM.

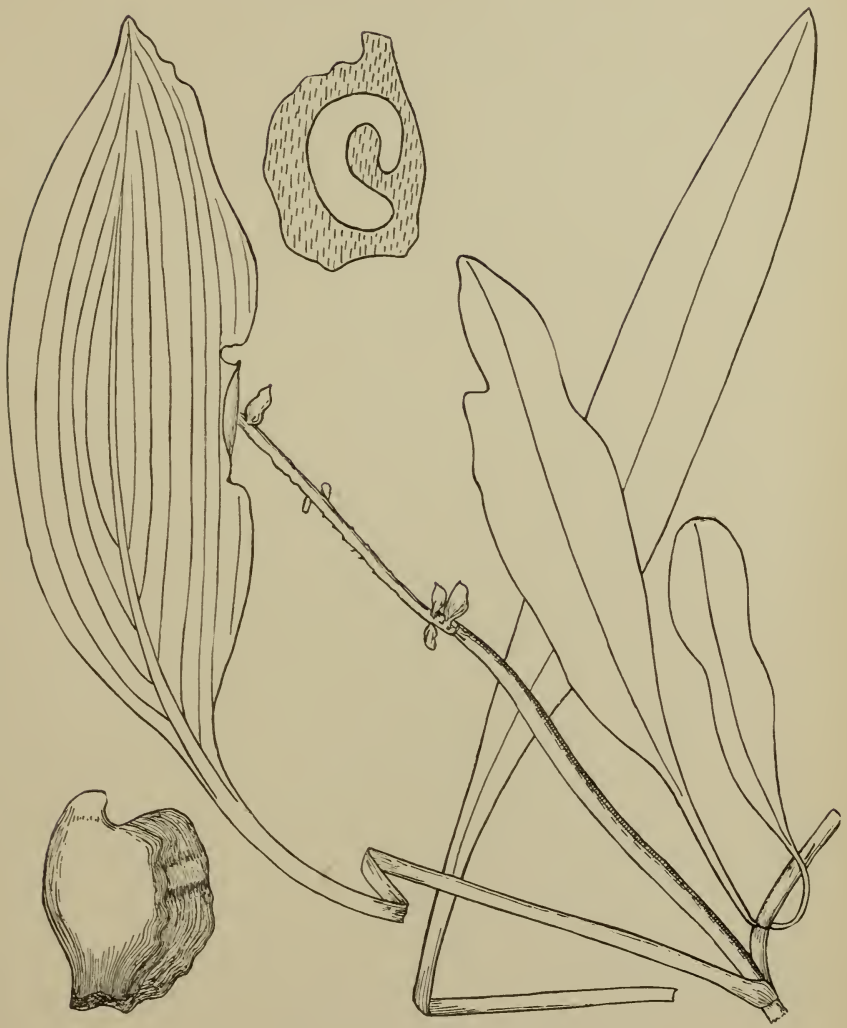
POTAMOGETON PULCHER, TUCKERM.

POTAMOGETON NUTTALLII, C. & S.

POTAMOGETON ALPINUS, BALBIS.

POTAMOGETON LONCHITES, TUCKERM.

POTAMOGETON FAXONI, MORONG.



POTAMOGETON MEXICANUS, A. BENNETT.

POTAMOGETON HETEROPHYLLUS, SCHREB.

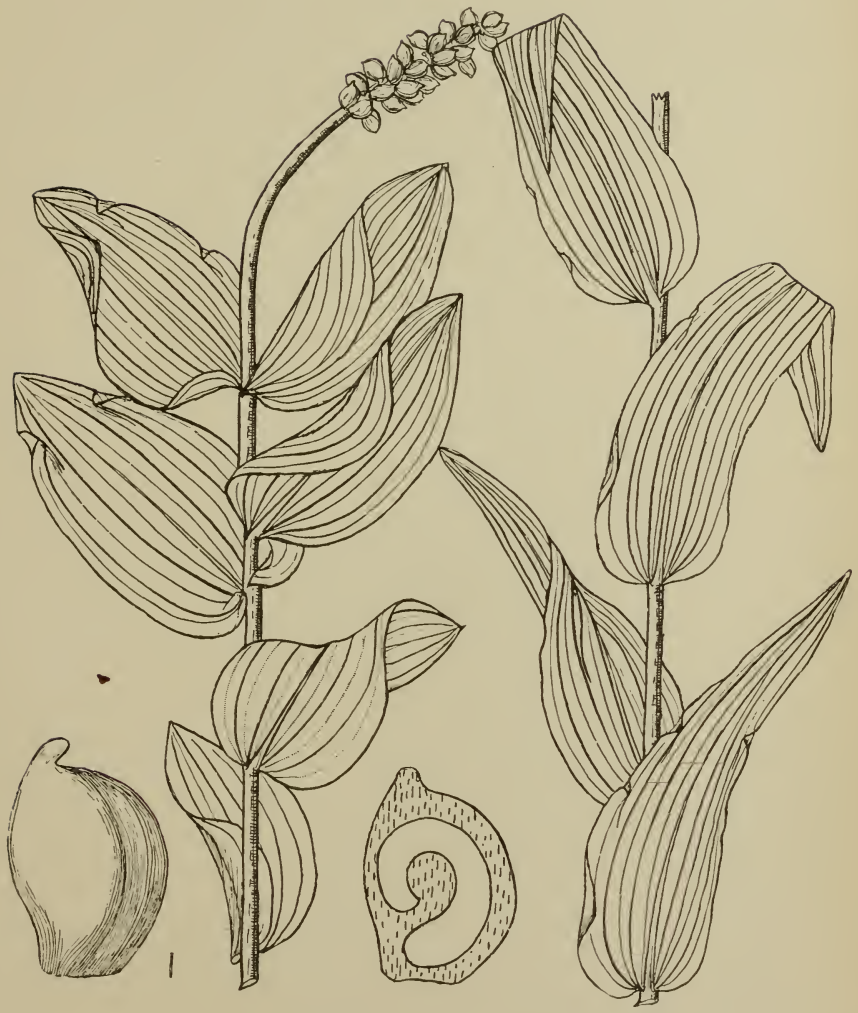
POTAMOGETON SPATHULÆFORMIS (ROBBINS) MORONG.

POTAMOGETON ILLINOENSIS, MORONG.

POTAMOGETON ANGUSTIFOLIUS, BERCH. & PRESL.

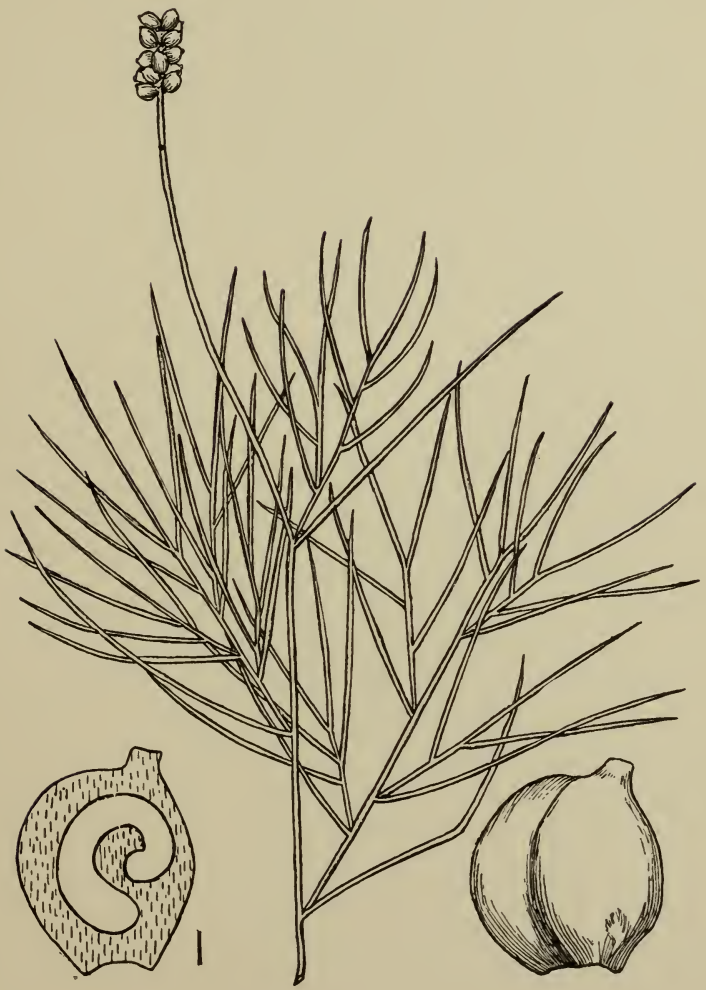
POTAMOGETON LUCENS, L.

POTAMOGETON PRÆLONGUS, WULF.



POTAMOGETON PERFOLIATUS, L.

POTAMOGETON MYSTICUS, MORONG.



POTAMOGETON CONFERVOIDES REICHENB.

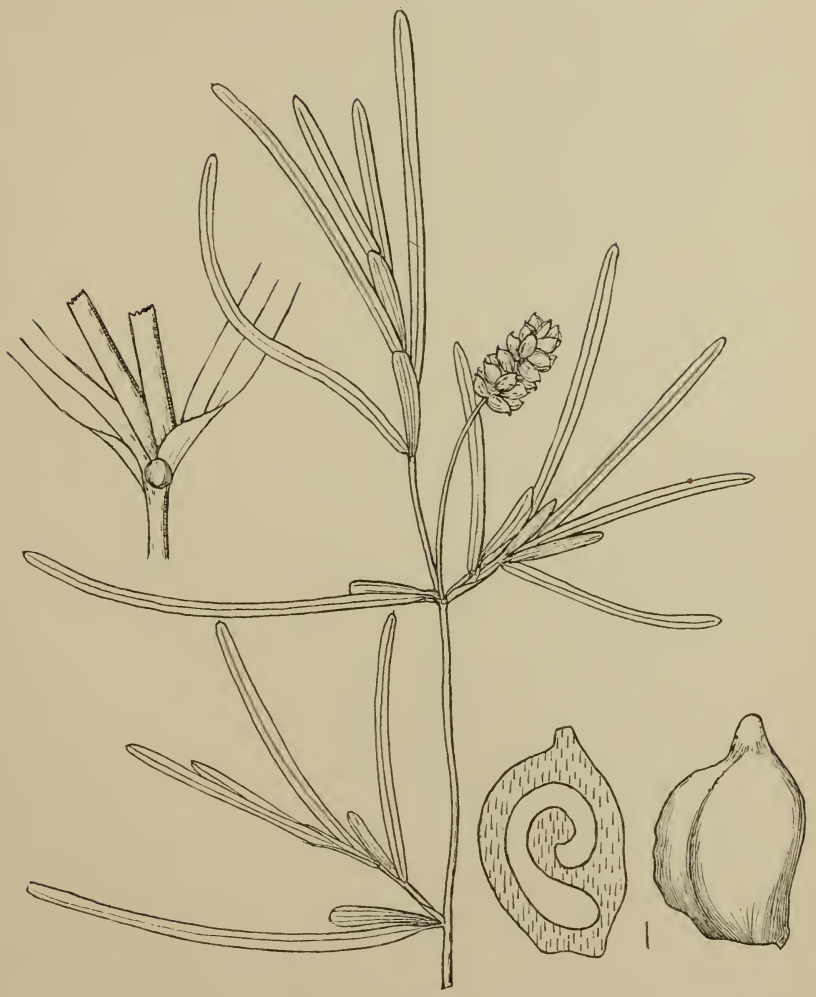
POTAMOGETON CURTISSII, MORONG.

POTAMOGETON CRISPUS, L.

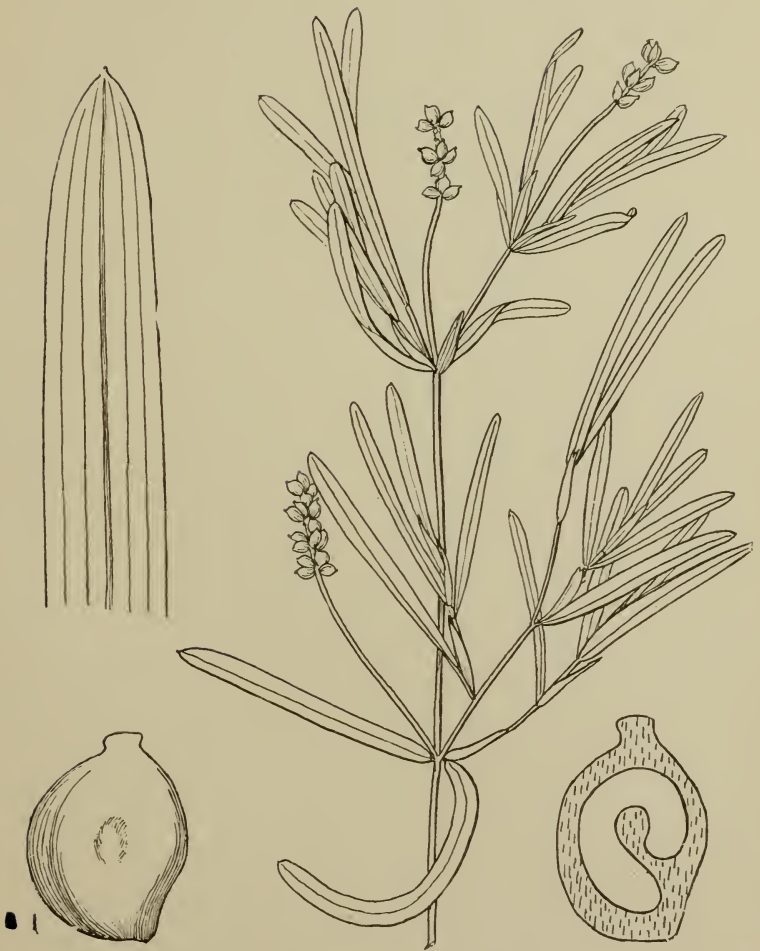
POTAMOGETON ZOSTERÆFOLIUS, SCHUM.

POTAMOGETON HILLII, MORONG.

POTAMOGETON FOLIOSUS, RAF.



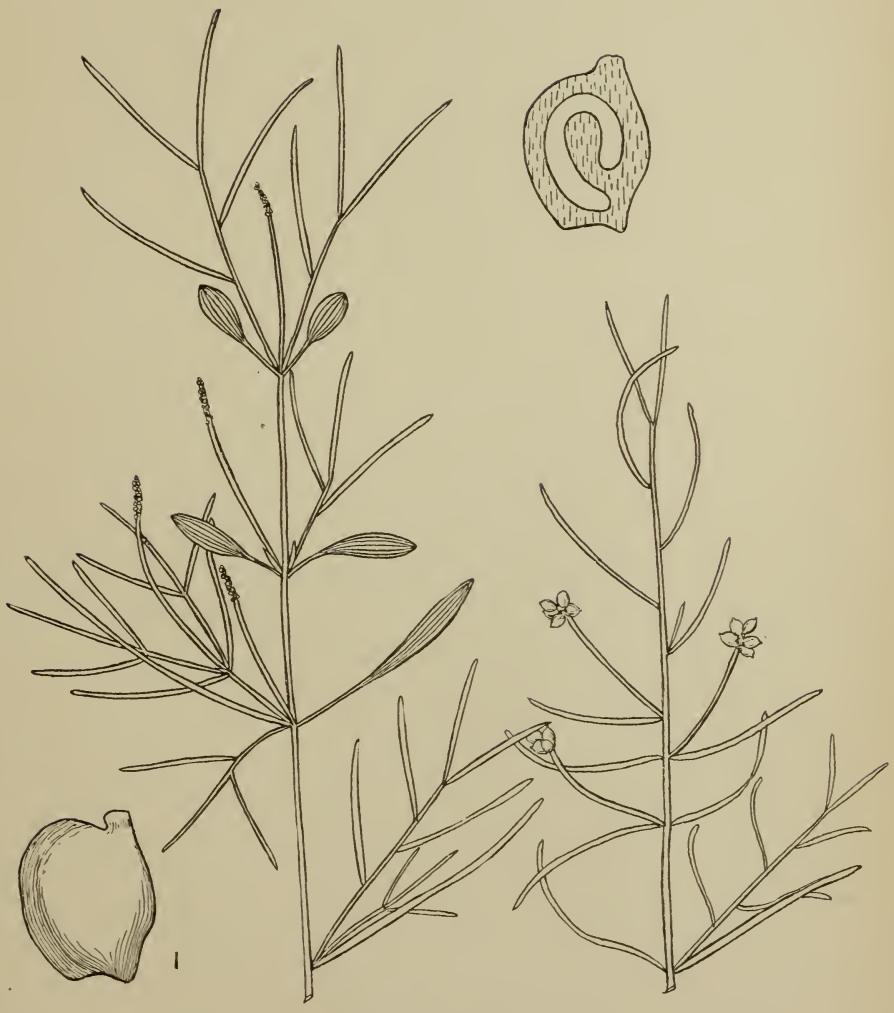
POTAMOGETON OBTUSIFOLIUS, M. AND K.



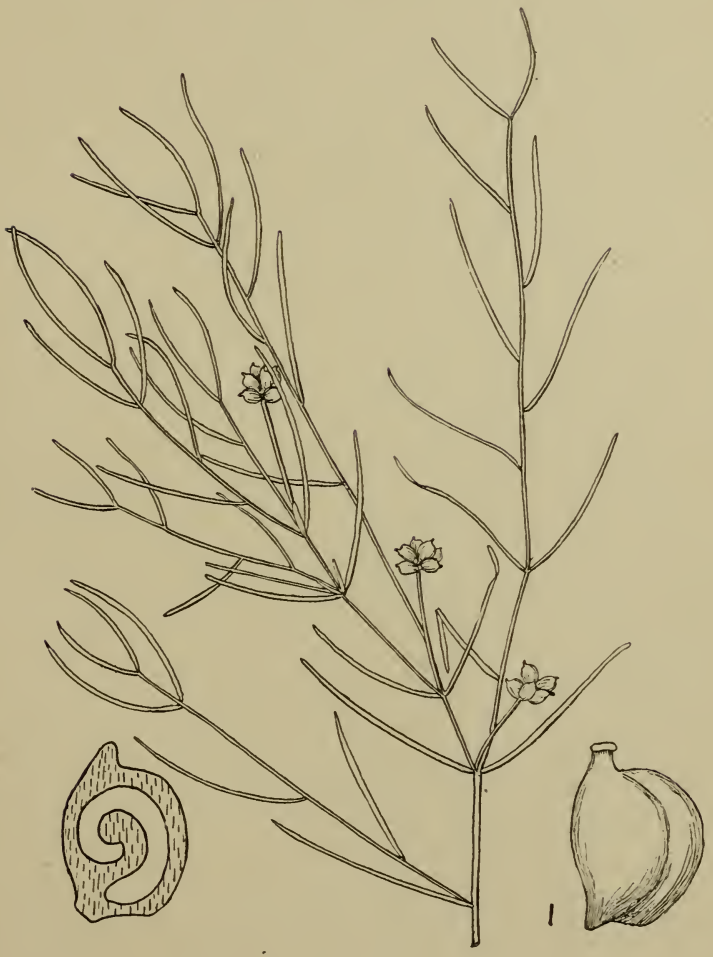
POTAMOGETON MAJOR (FRIES) MORONG.

POTAMOGETON RUTILUS, WOLFG.

POTAMOGETON VASEYI, ROBBINS.



POTAMOGETON LATERALIS, MORONG.

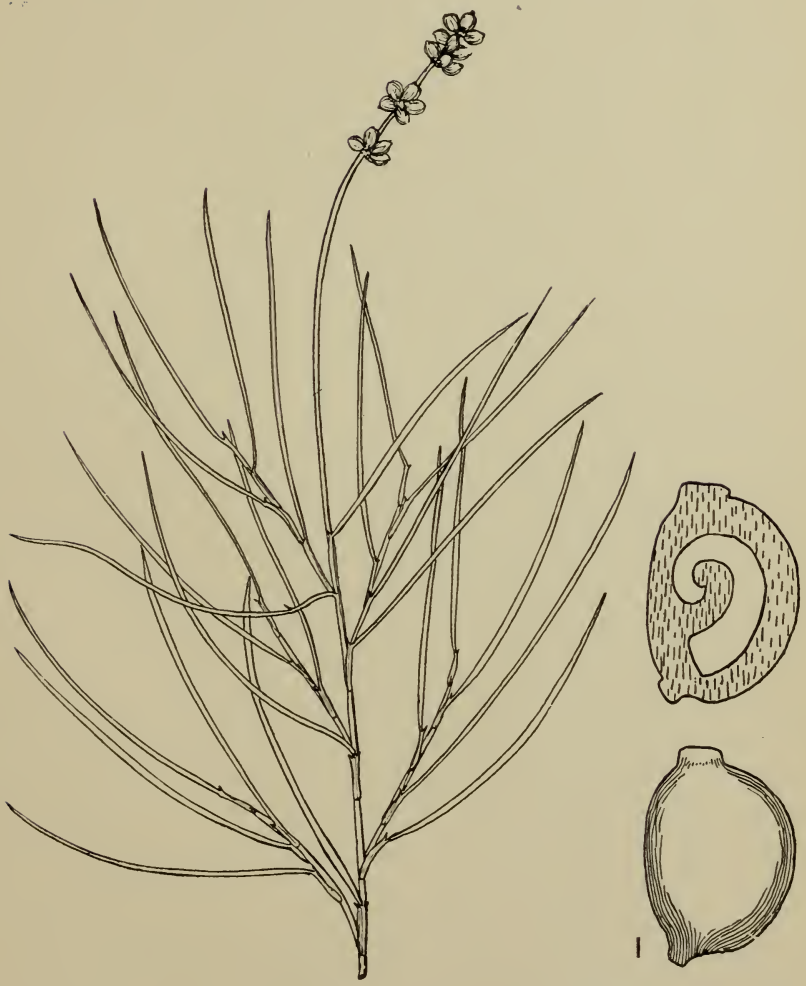


POTAMOGETON PUSILLUS, L.

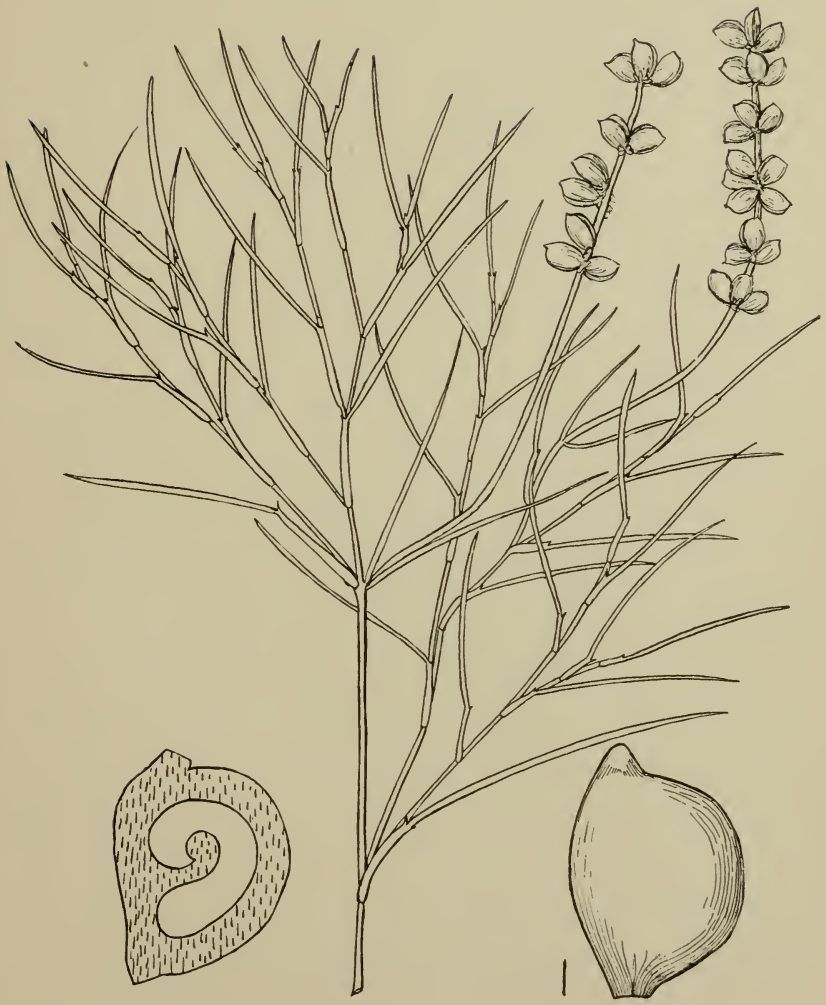
POTAMOGETON GEMMIPARUS (ROBBINS) MORONG.

POTAMOGETON DIVERSIFOLIUS, RAF.

POTAMOGETON SPIRILLUS, TUCKERM.



POTAMOGETON FILIFORMIS, PERS.



POTAMOGETON PECTINATUS, L.

POTAMOGETON LATIFOLIUS (ROBBINS) MORONG

POTAMOGETON INTERRUPTUS, KIT.

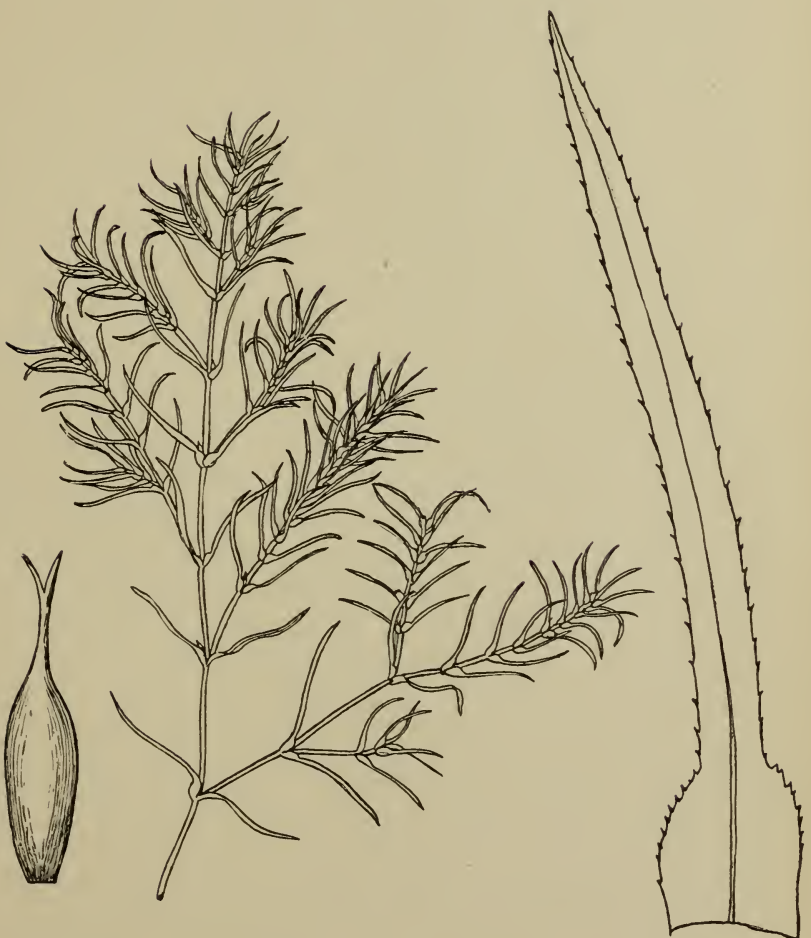
POTAMOGETON ROBBINSII, OAKES.

RUPPIA MARITIMA, L.

RUPPIA OCCIDENTALIS, S. WATSON.

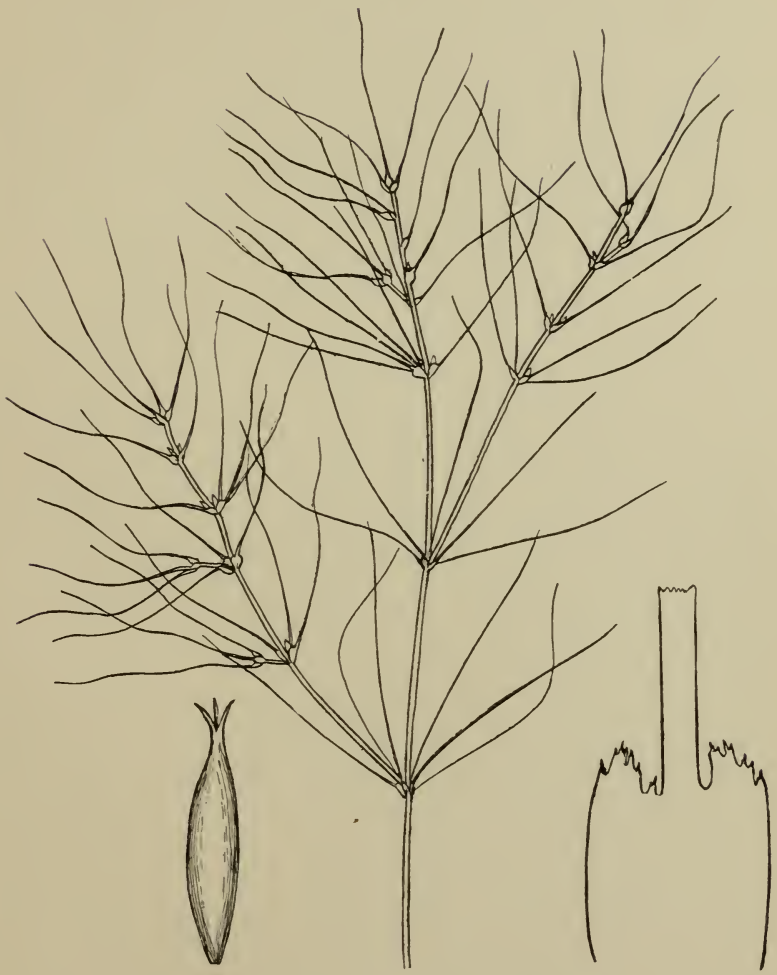
ZANNICHELLIA PALUSTRIS, L.

NAIAS MARINA, L.

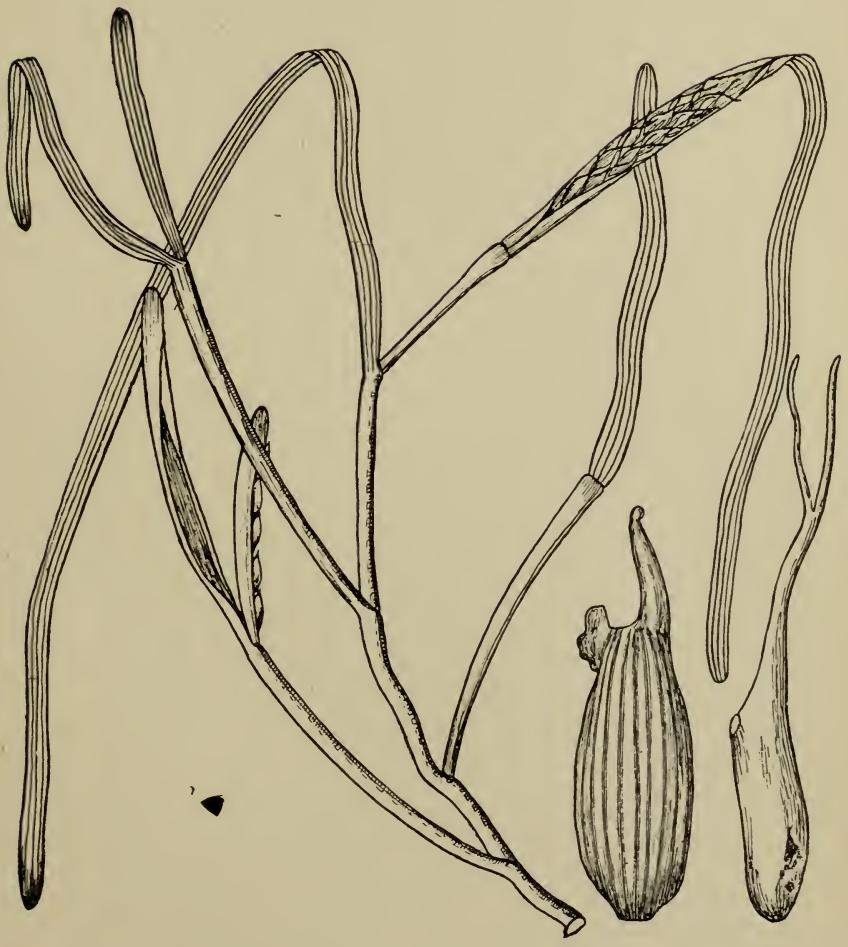


NAIAS FLEXILIS (WILLD.) ROSTK. AND SCHM.

NAIAS GUADALUPENSIS (SPRENG.) MORONG.

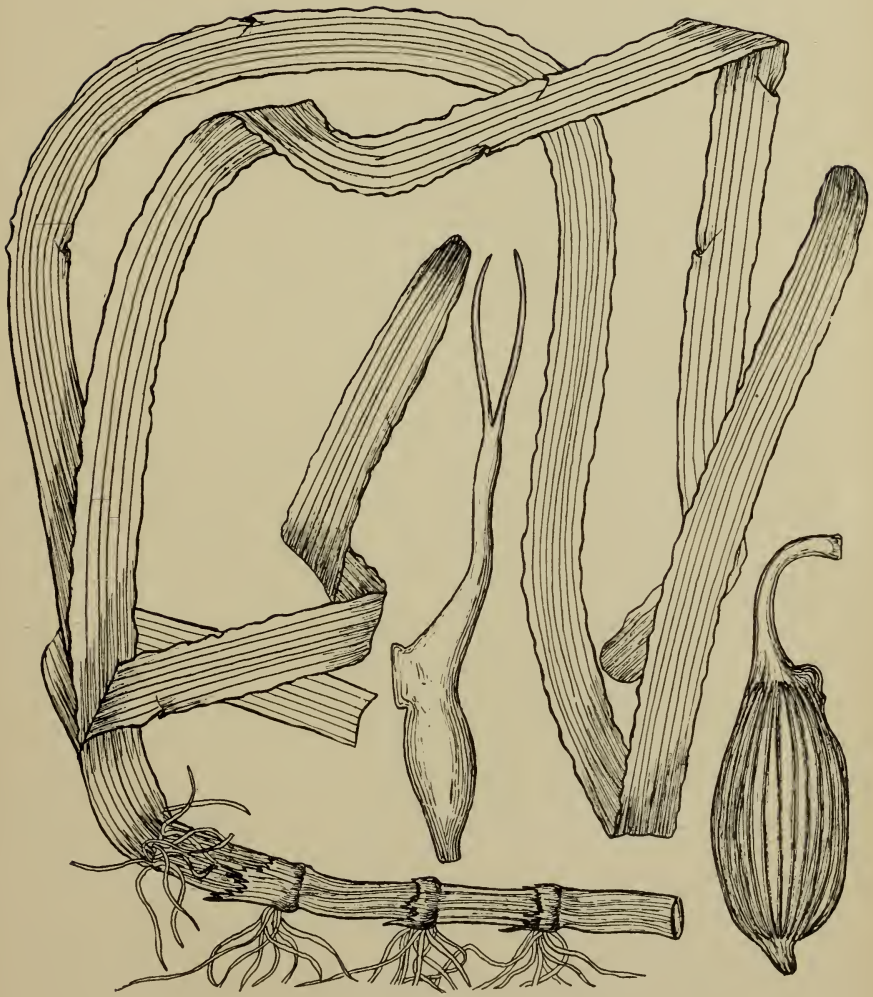


NAIAS GRACILLIMA (A. BR.) MORONG.

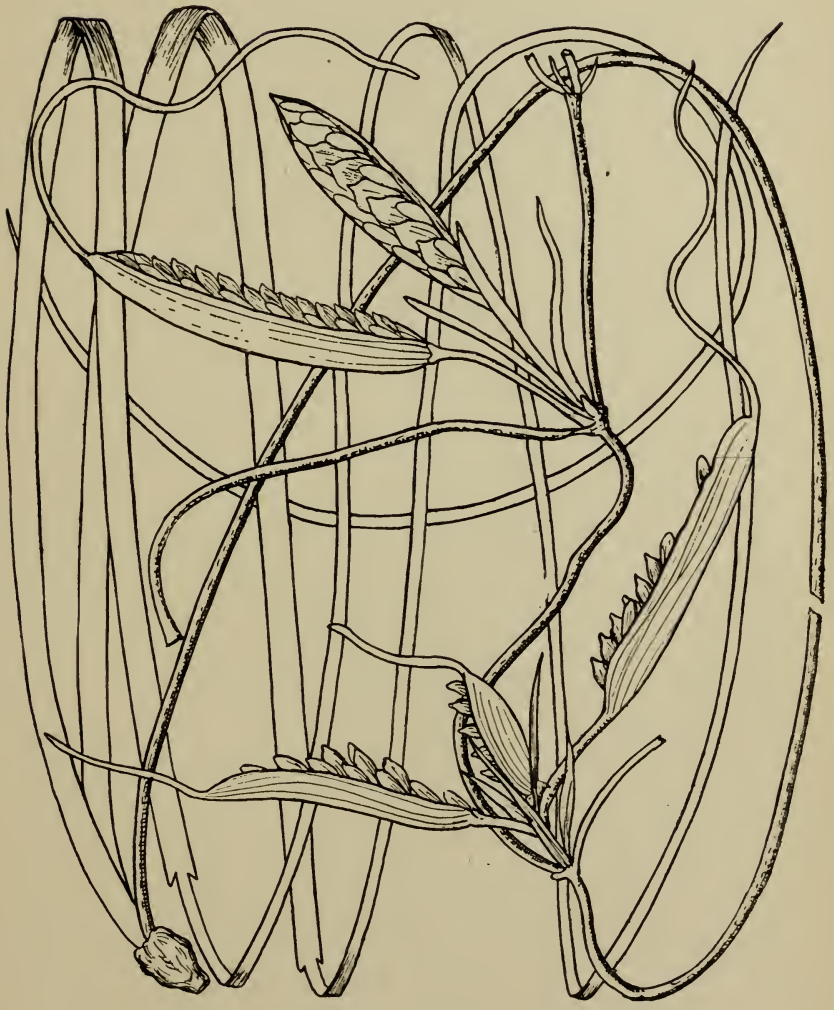


ZOSTERA MARINA, L.

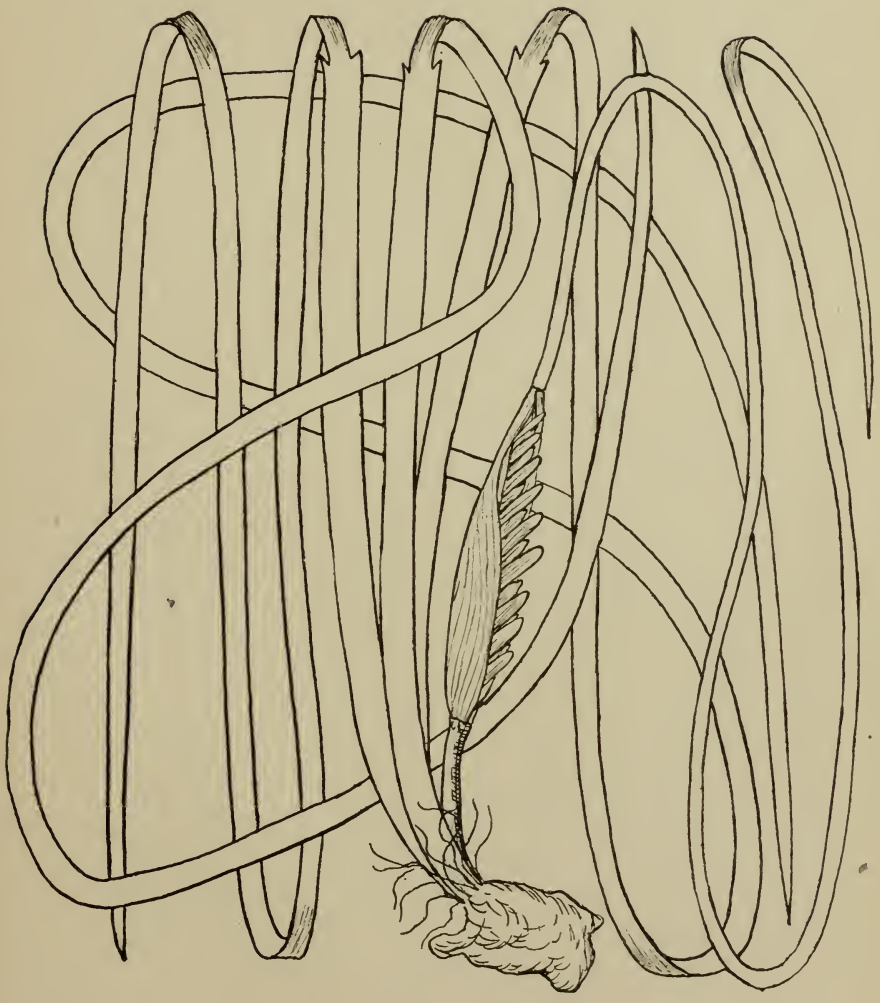
NAIAS MINOR (CAVOL) NOLTE.



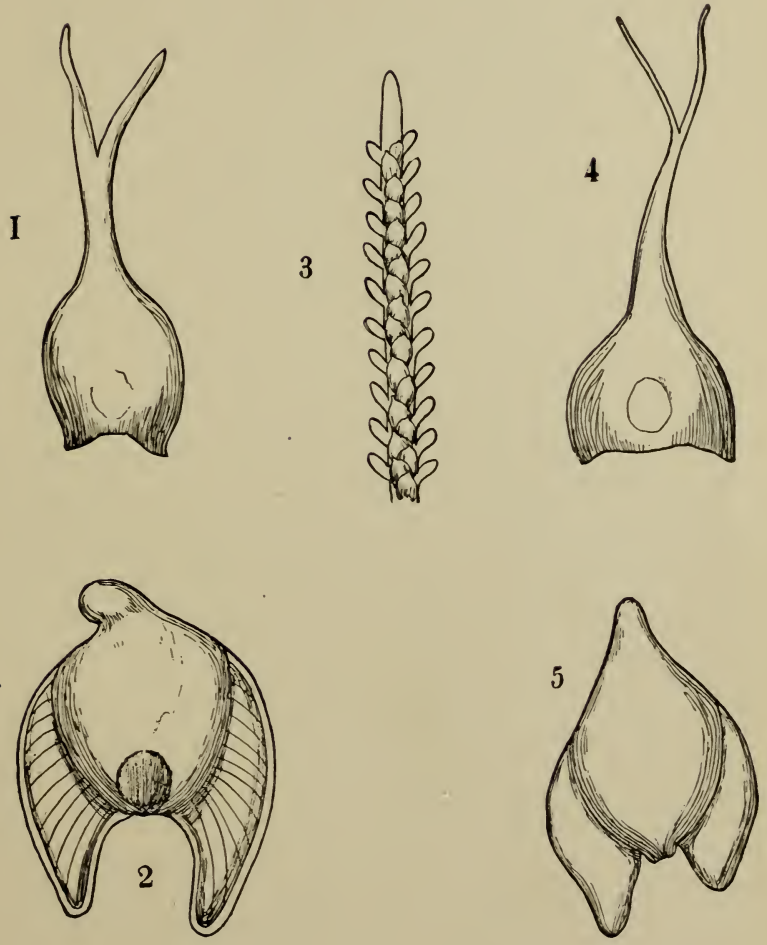
ZOSTERA LATIFOLIA, MORONG.



PHYLLOSPADIX TORREYI, S. WATSON.



PHYLLOSPADIX SCOULERI, HOOK.



PISTILS, SPADIX AND FRUITS OF PHYLLOSPADIX.
1, 2. P. SCOULERI. 3, 4, 5. P. TORREYI.

3 5002 03306 3079

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